

# FortiGate Connector for Cisco ACI - Administration Guide

Version 1.2

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Tuesday, June 14, 2016

FortiConnector for Cisco ACI v. 1.2 - Administration Guide

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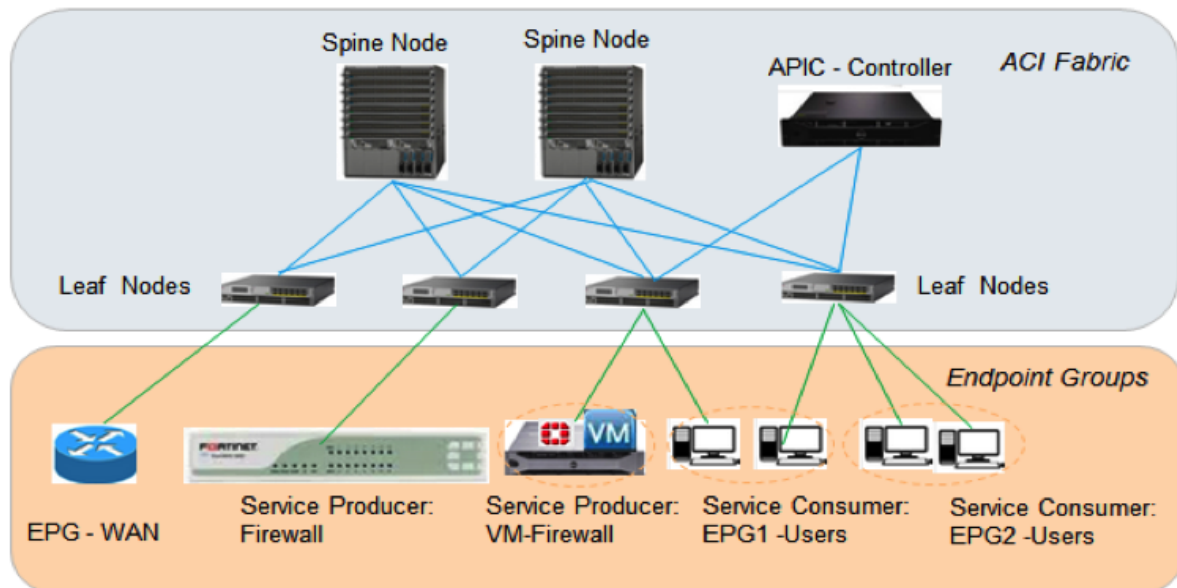
## Change Log

Date	Change Description
2016-05-09	Initial Release of version 1.2
2016-06-14	Deploying High Availability Service with Cisco ACI and FortiGate

# Overview

FortiGate Connector for Cisco ACI (Application Centric Infrastructure) is the Fortinet solution to provide seamless integration between Fortinet Firewall (Fortigate) deployments and the Cisco APIC (Application Policy Infrastructure Controller). This integration allows customers to perform single point of FortiGate configuration and Management operation through Cisco APIC.

While the FortiGate series of firewalls enable superb firewall services, in a data center environment, the insertion, configuration, and management of network services such as firewall can be quite complex and potentially error-prone tasks. One solution for such data center problems is Cisco's ACI. Cisco's ACI is a policy-based framework with integration of software and hardware in the underlying leaf-spine fabric. In Cisco ACI, the APIC is a tool used to automate service insertion and provisioning into the fabric of the network environment. Network service appliances, both physical and virtual, can be attached to ACI fabric's leaf node through APIC. Traffic demanding certain network services is steered by APIC-managed policies to the appropriate resources. The FortiGate Connector allows FortiGates to be included amongst the list of resources that traffic can be directed to.



## Licensing

FortiGate Connector for Cisco ACI is free of charge for Fortinet customers. You need to make sure that you register your FortiGate with FortiCare on [support.fortinet.com](https://support.fortinet.com).

## Terms and concepts

### FortiGate VDOMs

VDOM or Virtual Domain refers to a discretely administered segment on a FortiGate firewall. A FortiGate firewall that is not segmented and where a single administrator can access all of the firewall is operating in the “root” VDOM. However, it is possible to segment the FortiGate so that different administrators can access different areas of the FortiGate. Credentials for VDOM X will allow access to the resources and settings of VDOM A but no other. There will also be global resources and settings that will require credentials to the root VDOM. When setting up connectivity between Cisco APIC and the FortiGates it will be important to know which VDOMs control the needed resources.

### FortiOS RESTful API

REST (sometimes spelled ReST) stands for Representational State Transfer. It is a software architectural style for the WWW. REST systems typically communication over HTTP, using HTTP verbs or commands to retrieve and send information to remote servers.

A good resource for the finer details of Fortinet’s implementation of ReST can be found at [http://docs.fortinet.com/uploaded/files/1276/FortiAuthenticator\\_REST\\_API\\_Solution\\_Guide.pdf](http://docs.fortinet.com/uploaded/files/1276/FortiAuthenticator_REST_API_Solution_Guide.pdf)

### North/South and East/West Traffic

The cardinal compass direction terms to describe traffic flow are used to differentiate between traffic within the cloud or data center and traffic going in and out of the cloud or data center.

- North/South - traffic either heading into or out of a cloud or data center.
- East/West - traffic that is between nodes inside the same cloud or data center.



# Features

There are a number of features associated with firewalls in general and FortiGate firewalls in particular. This section should explain which of these features are available through the FortiGate Connector and which are not.

## Supported Features

The FortiGate Connector for Cisco ACI supports the following functions:

- Cisco ACI service insertion - software package for FortiGate device deployed to Cisco APIC, containing FortiGate models, function description, version, credentials, as a L4-L7 service.
- Enable tenant configuration to add/modify/delete L4-L7 device of FortiGate firewall service.
- Enable FortiGate deployment as both physical and virtual device (FortiGate chassis & VM).
- Support both transparent (GoThrough) and L3 (GoTo) device mode .
- Automatically create VDOM (context). One VDOM per logical device under a tenant.
- Enable FortiGate specific interface configuration: physical interface and port channel.
- Support IP address configuration on Layer 3 interfaces.
- Support subnet, service and schedule object configuration.
- Enable FortiGate firewall device to connect to endpoint groups (EPGs).
- Support IPv4 policies: match, action, network operations & security features selection (although the Enable/Disable Security profile option in policies is not supported).
- Support NAT.
- Enable service graph to add/modify/delete FortiGate firewall service node.

## New to v.1.2

The Fortigate Connector v1.2 for Cisco ACI has added support for the following functions:

- High Availability (Active-Standby Mode)
- OSPF based routing configuration in the L3 (GoTo) mode
- Support for logging and error reporting of Fortigate as a L4-L7 device
- Automatically create VDOM based on APIC virtual device ID
- Policy enable/disable support
- Enable/Disable DDoS features
- Enable/Disable UTM Security Profiles

## Unsupported Features

The following features normally found on FortiGates are not supported through the FortiGate Connector for Cisco ACI.

- Proxy Policy
- SSL/SSH Inspection
- FortiGate WAN load balance link.
- Administrator profile for limited access of different administrator accounts.
- Firewall port forwarding (destination NAT).
- Firewall logging: allowed traffic, security events, all sessions, etc.
- Firewall packet capture.
- Firewall with FortiGuard DDNS.
- Other Firewall features not specifically listed as supported.

The following information resources are available on the FortiGates but do not integrate with APIC:

- Error Logs
- Statistics Reporting

The unsupported features on APIC may still be used on FortiGate outside of the APIC control; the user must login to FortiGate to configure, monitor, and debug. However, any conflict with the operations from APIC may cause malfunction.

## Planned for future releases

FortiGate Connector for Cisco ACI plans to incorporate the following features and functions into future versions of the software:

- Support for BGP-based routing configuration in the L3 (GoTo) mode from APIC.
- Monitor FortiGate devices (health) status.
- Provide FortiGate device statistics – device and service counters per context.
- Support D-NAT configurations
- Support IPv6 policy configurations
- Performance reporting: control and management plane based on APIC, data path on FortiGate.
- Support of Dynamic EPG

New features are not limited to this list. These are just the features currently planned for.

# Supported Fortinet Products

The supported Fortinet products refers to those that are compatible with the FortiGate Connector for Cisco ACI software, and will properly integrate into the Cisco ACI. The products are separated into models and firmware but it is an “and” set of parameters. In order to be supported the Fortinet product has to be one of the listed models running supported firmware.

## Models

FortiGate Connector for Cisco ACI v1.1.x and 1.2.x support integration with the following predefined models:

- FG-600D
- FG-900D
- FG-1000D
- FG-1200D
- FG-1500D
- FG-3000D
- FG-3100D
- FG-3200D
- FG-3700D
- FG-VM
- Unknown (to be added based on customer's request)

## Firmware Versions

FortiGate Connector v1.2 for Cisco ACI is compatible with the following FortiOS firmware:

- FortiOS 5.4 and above

# Prerequisites

## Cisco Side

Before the FortiGate Connector for Cisco ACI can be successfully deployed, a number of prerequisites need to be satisfied within the Cisco environment.

One of the following Cisco ACI environments needs to be in place:

- Cisco ACI v1.2(2.g) or later

Within the Cisco ACI, the following configurations need to be completed before Layer 4 -7 Services (in this case, the FortiGate Connector) can be deployed:

- Creation of Access Policies configuration under Fabric menu
- Creation of any need Tenant(s)
- Creation of Network(s) (including Bridge Domain)
- Creation of Application Profile(s)
- Creation of End Point Group(s)
- Creation of Contract(s)
- Create OSPF L3Out (Only if OSPF is required)

For detail, please consult Cisco APIC deployment Guide.

[http://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/1-x/L4-L7\\_Services\\_Deployment/guide/b\\_L4L7\\_Deploy.html](http://www.cisco.com/c/en/us/td/docs/switches/datacenter/aci/apic/sw/1-x/L4-L7_Services_Deployment/guide/b_L4L7_Deploy.html)

## FortiGate Side

Before the FortiGate Connector for Cisco ACI can be successfully deployed, a number of prerequisites need to be satisfied on the FortiGate side of the equation.

### Physical Firewall

1. Configure administrator user name and password.
2. Enable http/https on mgmt. port.
3. Configure IP address in mgmt. port.
4. Enable VDOM-Admin globally.
5. Configure Port-Group if needed.

### VM Firewall

1. Assign network ports before start VM
2. Configure administrator user name and password.
3. Enable http/https on mgmt. port.

4. Configure IP address in mgmt. Ports
5. Enable VDOM-Admin globally

# Components of the Device Package

To add a network service to ACI fabric, the service's device package needs to be uploaded to APIC. The device package is a zip file containing these components:

## Device model or specification

The Device Specification is an XML file called `DeviceModel.xml` that covers descriptions of FortiGate devices, interfaces, connectivity and services. The file contains a hierarchical description of FortiGate devices, including:

- Device functions
- Parameters of each function
- Interfaces/network connectivity information of each function.

## Device script

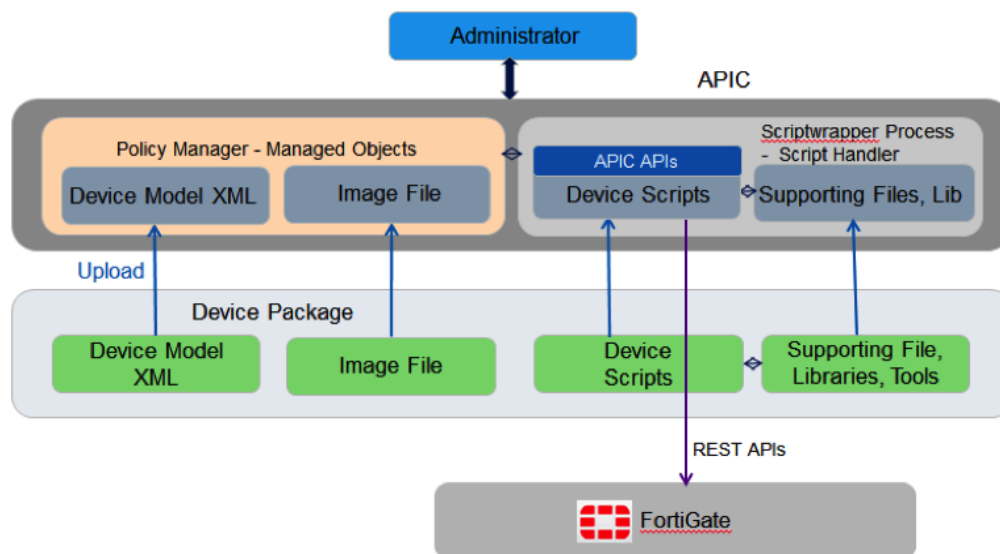
This is a Python file, `DeviceScript.py` with API functions to interface between the Cisco APIC and the FortiGate REST APIs. This Python file is associated by the `DeviceModel.xml` device specification to device script for APIC.

## Directory of supporting files

This component contains supporting Python files, text files and libraries of scripts and tools.

## Image file or directory

The directory contains file(s) such as a Fortinet icon (`Fortinet_name.gif`) to be displayed on the APIC management page.



## Operational modes

There are two types of network service devices which Cisco APIC integrates with. These types of devices are defined by their operation mode. They are either Go Through or Go To. Normally a device has to be preconfigured as one of these types before its imported package is managed by the APIC.

### Go Through Mode (Layer 2)

Devices in Go Through mode are considered layer 2 devices (from the OSI model) and are sometimes known as transparent. They are referred to as transparent because while the traffic goes through them and can be affected by them, they are not seen by the network and are not a destination in their own right for the traffic. They do not route traffic. These devices are not referred to by the packet's destination MAC or IP address. In most cases, these devices will only have an address for the purposes of management.

### Go To Mode (Layer 3)

Devices in Go To mode are considered Layer 3 (from the OSI model) devices. They can route traffic and they are referenced as the destination in a packet's destination MAC address or destination IP address.

## Multi-tenant multi-device support

- Multi-tenant Multi-device is typical in the use cases of this project. The support is worth more detailed description. When FortiGate device is added a tenant's L4-L7 services, multi-context aware can be enabled. This indicates to the device package that the L4-L7 device is going to be a virtual device that shares resources with other tenants on the FortiGate. In FortiGate implementation, this virtual device is represented by a VDOM. Under each tenant, multiple such virtual devices can be configured. VDOM name is the virtual device ID generated by APIC when a virtual device is added.
- Each tenant sees all available interfaces and can share interfaces (ports) with other tenants, if it is multi-context aware. For Physical Device under L3 Routed (GoTo) Mode, Tenant can share physical interface as VLAN is used to isolate the physical interface. In VM Device, this is not true. You can only use dedicated VNIC.

# Supported use scenarios

## Physical Fortigate

### **Go-Through Mode for west-east traffic within data center in ACI.**

Scenario: Web server and back-end database servers have same subnet in data center; customer needs firewall service between web server and back-end database servers.

### **Go-To Mode for north-south traffic for Web Server to access DataBase server in data center.**

Scenario: Firewall service for Web Server to access DataBase server in data center.

## Virtual Fortigate

### **Go-Through Mode for west-east traffic within data center in ACI.**

Scenario: Web server and back-end database servers have same subnet in data center; customer needs firewall service between web server and back-end database servers.

### **Go-To Mode for north-south traffic for Web Server to access DataBase server in data center.**

Scenario: Firewall service for Web Server to access DataBase server in data center.



# Deployment Procedures

Below sections, we will walk through the high level of how to deploy a service insertion as well as detail procedures of how to perform each steps.

## Device package installation

To successfully deploy Fortigate Connector into Cisco APIC, customers need to perform the following steps:

1. Import Device Package
2. Add L4-L7 Device
3. Create Functional Profile
4. Create Service Graph Template
5. Deploy Service Graph Template.

## Service Deployment

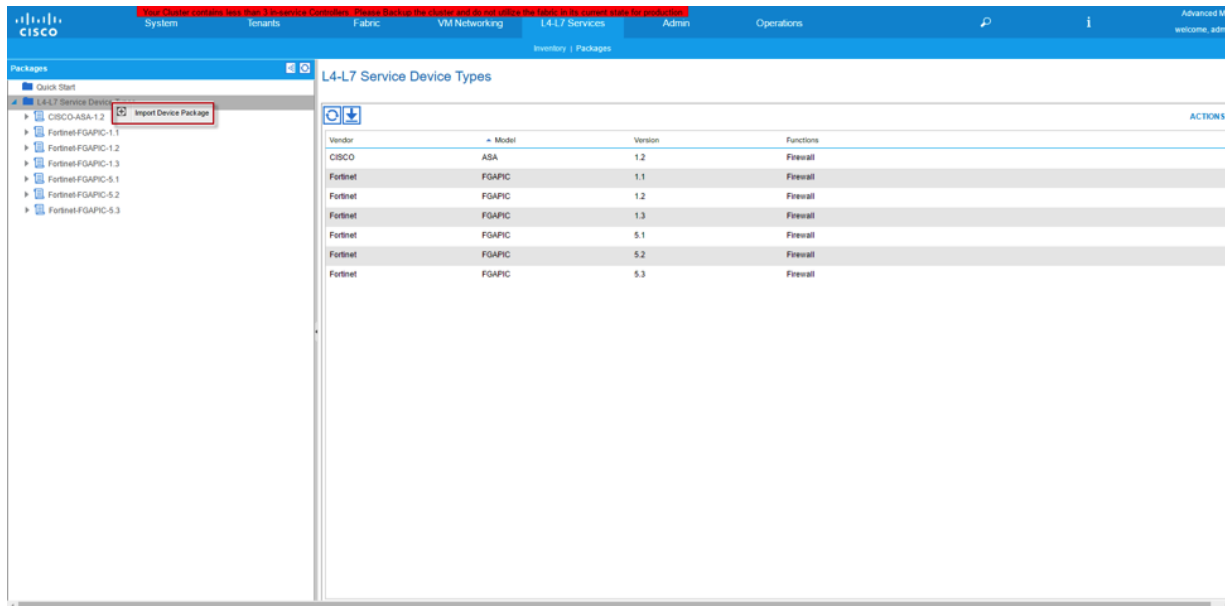
According to the APIC deployment guide, a service device introduces a Layer 4 to Layer 7 service by this typical procedure:

1. Import the device package of the service device,
2. Configure a tenant who asks for network services,
3. Register the device and its logical interfaces,
4. Configure logical device parameters,
5. Configure a layer 3 network,
6. Configure a bridge domain,
7. Configure an application profile,
8. Configure a physical domain (or VMM domain),
9. Configure a VLAN pool,
10. Configure a contract
11. Configure a management endpoint group (EPG),
12. Configure a service graph template,
13. Select default service graph template parameters,
14. Attach the service graph template to a contract
15. Configure additional configuration parameters.

To add a support of a non-Cisco firewall device in the Cisco ACI fabric based data center, a device package should be developed for the APIC. Then the remaining task is standard APIC deployment of a network service device.

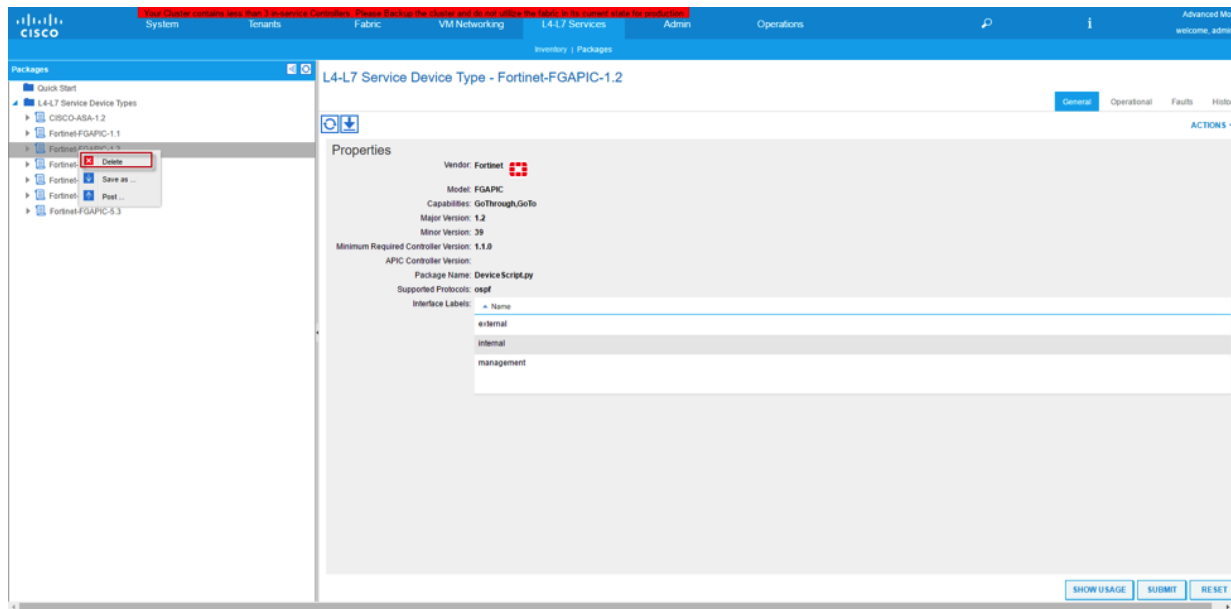
## Importing the Device Package

1. Download Device Connector Package from Fortinet Support Web (URL) site to local storage.
2. From APIC menu, Navigate to **L4-L7 Services > Packages** and right click on **L4-L7 Device Type** on the left hand panel. Select **Import Device Package**



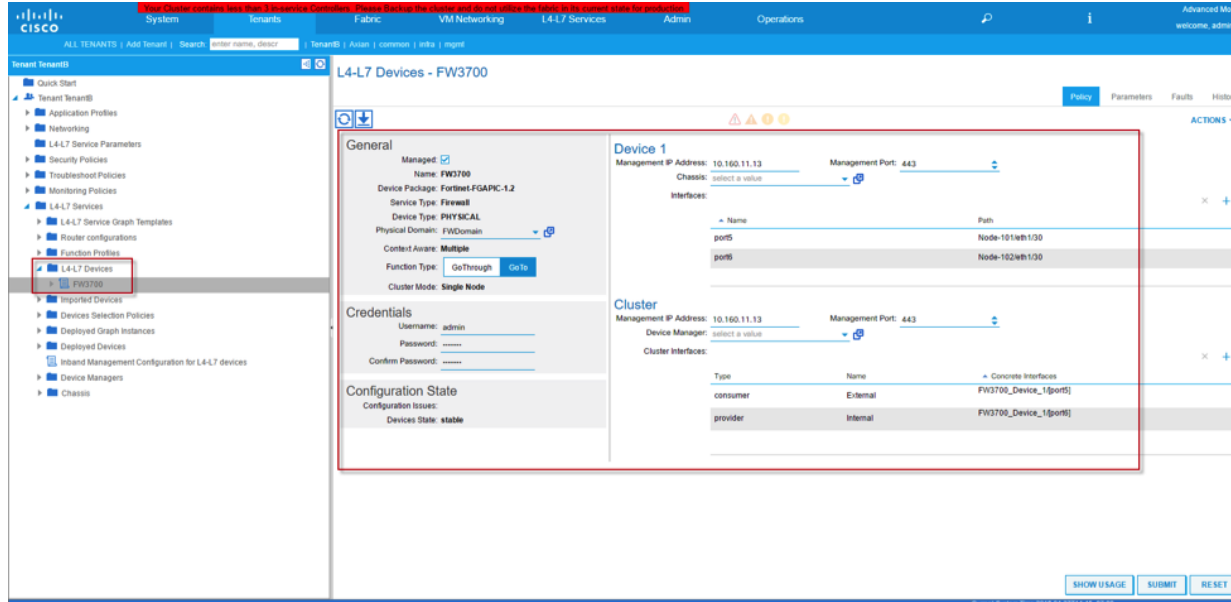
## Remove Device Package

To remove Device Package, navigate to **L4-L7 Services > Packages** and right click on the Device package on the left panel and select **Delete** option.



## Add L4-L7 Device

Within Tenant, Expand **L4-L7 Services > L4-L7 Devices**, right click on mouse and select “**Create L4-L7 devices**”



## GENERAL

Field	Description / Options
Name	Name of the Device
Device Package	Select Device Package from drop down list
Model	<List of the supported models>
Mode	<ul style="list-style-type: none"><li>• Single Node / HA Cluster</li></ul>
Function Type	<ul style="list-style-type: none"><li>• GoThrough (L2)</li><li>• Goto (L3)</li></ul>

## CONNECTIVITY

Field	Description / Options
Physical Domain or VMM Domain	Select from drop down list Domain which you should have configured during APIC Access Policies setup
APIC to Device	<ul style="list-style-type: none"><li>• Out-of-Band</li><li>• In-Band</li></ul>

## CREDENTIALS

Field	Description
Username	<login name to the Fortigate>
Password	<Password to login to Fortigate>
Confirm Password	<Password to login to Fortigate>

## Device 1

Field	Description / Options
Management IP Address	<IP address to connect to Fortigate>

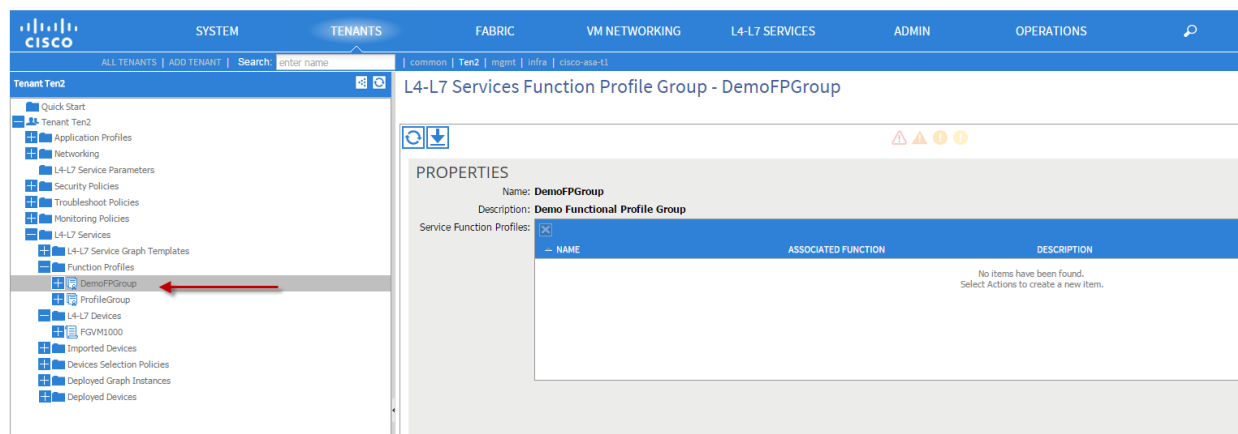
Field	Description / Options
Management Port	<ul style="list-style-type: none"> <li>• http</li> <li>• https</li> </ul> <p>https is the prefer method</p>
Connects To	<ul style="list-style-type: none"> <li>• Port (Default), PC, VPC</li> </ul>
Physical Interfaces	Click on “+” sign to add interfaces connecting from APIC to FortiGate
Name	<p>Select from Drop down list to select port.</p> <p>(If using Port Channel, please type in the correct Port Channel name ex:PO1, PO2..etc.)</p>

## Cluster

Configure all the fields same as Device 1, with exception to Cluster Interface.

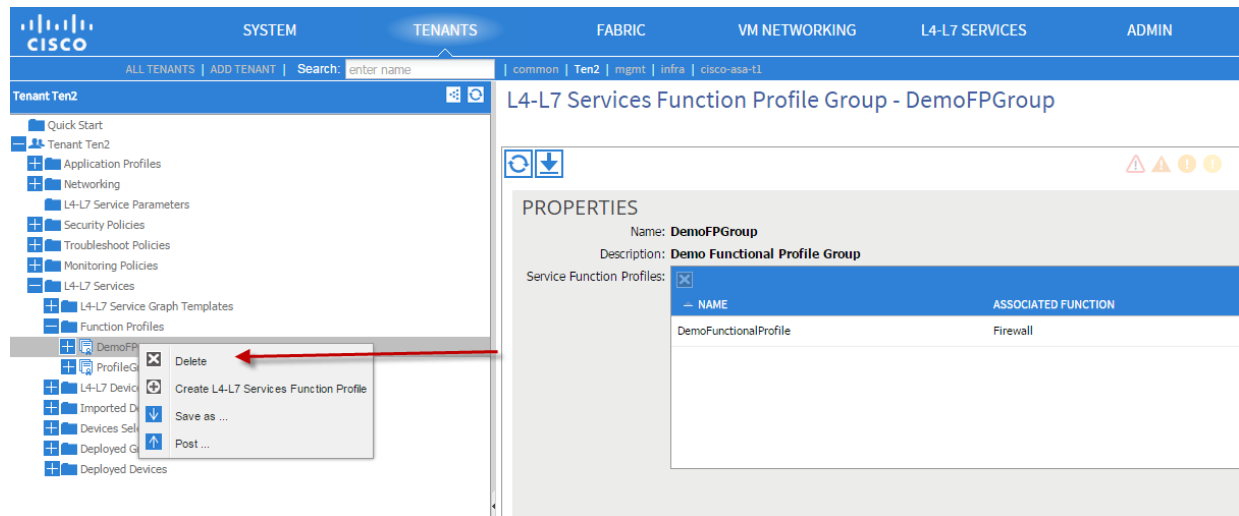
For Cluster Interface, click the “+” icon to add logical device interfaces.

## Create Functional Profile Group



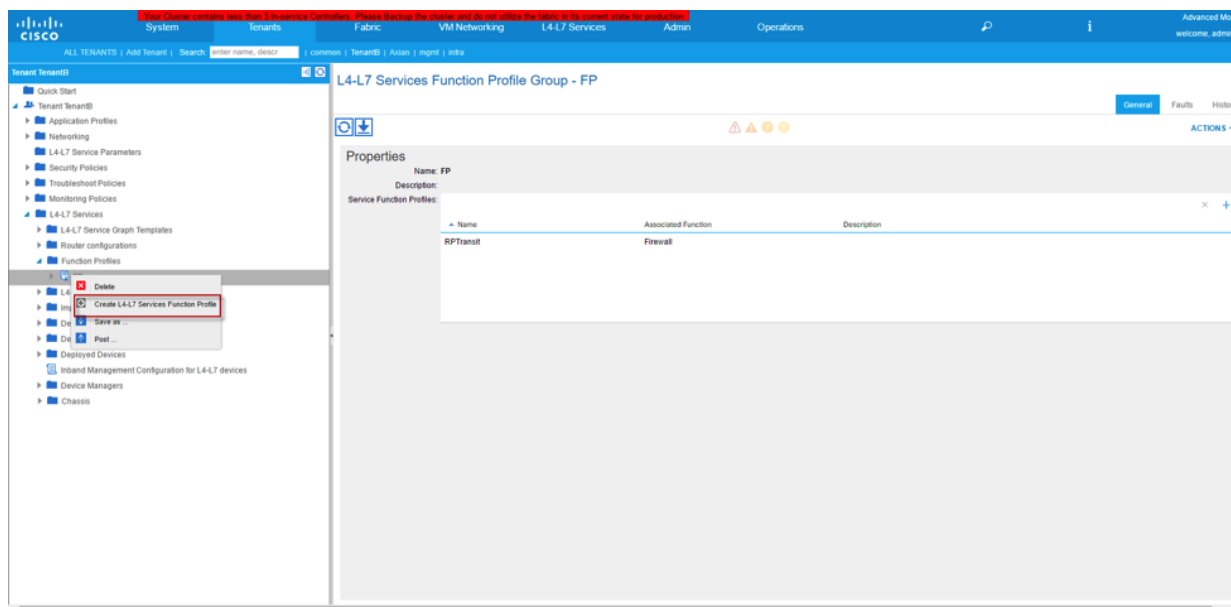
## Remove Functional Profile Group

To remove Functional Profile Group, navigate to **Tenant > L4-L7 Services > Functional Profiles** and right click on the Functional Profile group name listed on the left hand panel and select **Delete** option.



## Create a Function Profile

Functional Profile defines the template for the Service(s) that is going to deploy such as L4-L7 Device Interface IP addresses, Rule ID, Object Addresses, Policy Rules, Source/Destination Ports...etc.



## Functional Profile Objects Explanation under “Features”:

### Device Network:

Contained External and Internal Interfaces that will be programmed onto Fortigate VDOM. This is the interfaces (typically external and internal) that will be associated to the VDOM. If user intends to have multiple legs deployment scenario, this is where he/she can add additional interfaces with unique name.



Beginning with FortiGate Connector v1.2, the device package no longer has the option to select VDOM mode and VDOM name. Instead, the VDOM name is automatically generated based on virtual device ID from APIC; the VDOM mode is based selection of Go-to mode and Go-through mode during the device creation. If Go-to mode is selected, user must input IP addresses and subnet mask for each interface; if Go-through mode is selected, user must leave IP address field untouched.

---

### Firewall Objects:

This field allows user to customize Firewall Addresses, Service and scheduling.

### Firewall Policy Rule:

This field encompassed the creation of Firewall policy that will be program onto FortiGate. Security Profile and Logging Options can be enabled or disabled here.

---



If user intends to use multiple service graphs shared by same virtual device, please ensure the rule ID, policy names are all unique across all service graphs. Otherwise, policy rules will overwrite each other.

---

We made changes on this release to allow better policy sorting function. The “Name” Column under FireWallPolicyRuleID (Figure 1) will only take numeric entry. This field is equivalent to “Policy ID” on the Fortigate. We have added additional sub-fields under this folder and they are “Name” and “OrderNo” respectively (Figure 2). The “Name” sub-field is equivalent to “Policy Rule Name” on the Fortigate and this field is optional. The “OrderNo” sub-field is a mandatory field where we leverage it to sort the ordering of the policy. The lower policy number will be listed first on the Fortigate. In the case of share VDOM with multiple service graphs, the rule above applied where the RuleID and policy names need to be unique.

### Figure 1

### Edit Function Profile

Click row to edit value

**Features:**

- [DeviceNetwork](#)
- [FirewallObjects](#)
- [FirewallPolicyRule](#)
- [StaticRouter](#)
- [All](#)

Basic Parameters
All Parameters

Folder/Param		Name	Value	Mandatory	Locked	Shared
	Function Config	Function				
+	FirewallPolicyRuleID(Number Only - EX. 1,2..)	10			false	false
	FirewallPolicyRuleID(Number Only - EX. 1,2..)	11			false	false
	FirewallPolicyRuleID(Number Only - EX. 1,2..)	20			false	false
	FirewallPolicyRuleID(Number Only - EX. 1,2..)	21			false	false

## Figure 2

**Edit Function Profile**

Click row to edit value

Features:

- [DeviceNetwork](#)
- [FirewallObjects](#)
- [FirewallPolicyRule](#)
- [StaticRouter](#)
- [All](#)

		Folder/Param	Name	Value	Mandatory	Locked	Shared
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Device Config	Device				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Function Config	Function				
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FirewallPolicyRule...	10			false	false
<input checked="" type="checkbox"/>	<input type="checkbox"/>	LoggingOptions	Logging			false	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	SecurityProfiles	SecurityProf...			false	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Action(accept/d...	Action	accept	false	false	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Destination Add...	DestAddress	all	false	false	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Enable This Pol...	status	enable	false	false	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Name	Name	10	false	false	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Nat(enable/dis...	Nat	disable	false	false	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	OrderNo	OrderNo	10	true	false	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Outcoming inter...	OutInterface	external	false	false	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Service	Service	ALL	false	false	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Source Address...	SourceAddr...	all	false	false	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Incoming interfa...	InInterface	internal	false	false	



## Static Router:

Allow user to configure static route that will be used on Fortigate.

## All:

This field listed all the parameters stated above plus DDOS configuration.



If user is using multiple legs shared by same virtual device, please ensure to select appropriate interface names created earlier from Device Network field

## Review

All Field display all the fields in the features listing. If you are satisfy with all your inputs, then hit the submit button to complete your creation of Functional Profile template.

**Create L4-L7 Services Function Profile**

Create Function Profile

Name: DemoFunctionalProfile

Description: optional

Copy Existing Profile Parameters: ☒

Profile: Fortinet-FGAPIC-1.0/Basic-Firewall-Policy

Features and Parameters

In order to auto apply new values to the parameters of existing graph instance when users modify function profiles, the name of top folder must be ended with - Default.

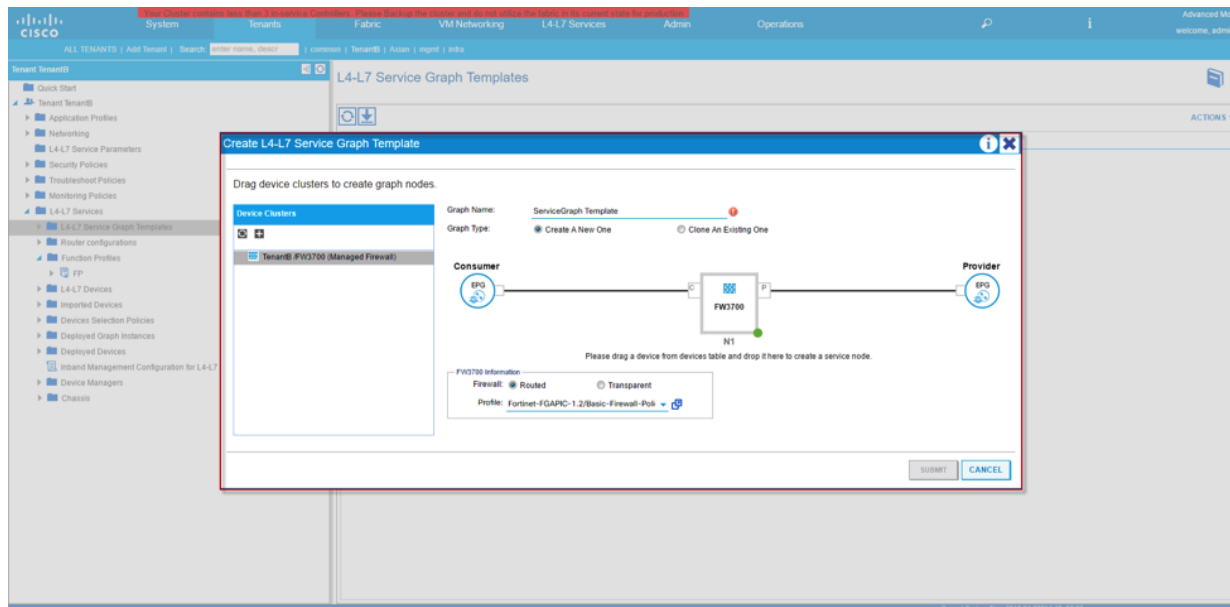
BASIC PARAMETERS		ALL PARAMETERS			
FOLDER/PARAM	NAME	VALUE	MANDATORY	LOCKED	SHARED
DeviceInterface	port11		false	false	false
DeviceInterface	port12		false	false	false
FirewallAddresses	Adobe_Login		false	false	false
FirewallAddresses	Gotomeeting		false	false	false
FirewallAddresses	None		false	false	false
FirewallAddresses	SSLVPN_TUNNEL_ADDR1		false	false	false
FirewallAddresses	Windows_update_2		false	false	false
FirewallAddresses	adobe		false	false	false
FirewallAddresses	all		false	false	false
FirewallAddresses	android		false	false	false
FirewallAddresses	apple		false	false	false
FirewallAddresses	ecostore		false	false	false

SUBMIT CANCEL

## Service Graph

### Create Service Graph

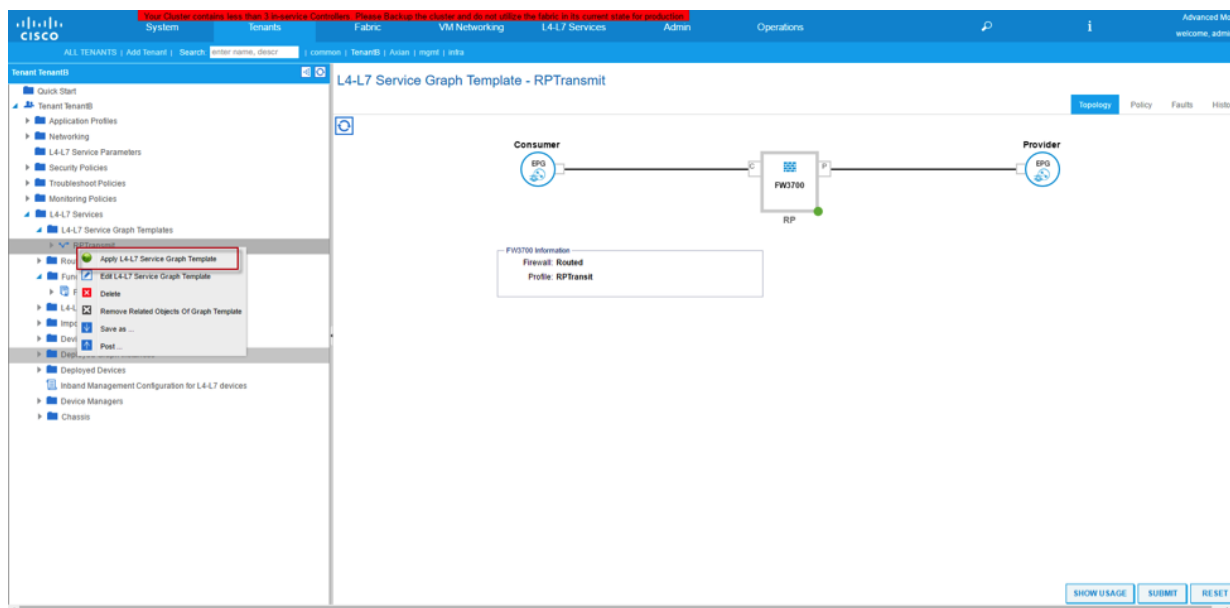
Service Graph template is used to tightly coupled the Functional Profile or Firewall configuration and combine with the Firewall device we defined at earlier steps.



Right Click on **L4-L7 Service Graph Template** to create a Service Graph.

## Deploy Service Graph

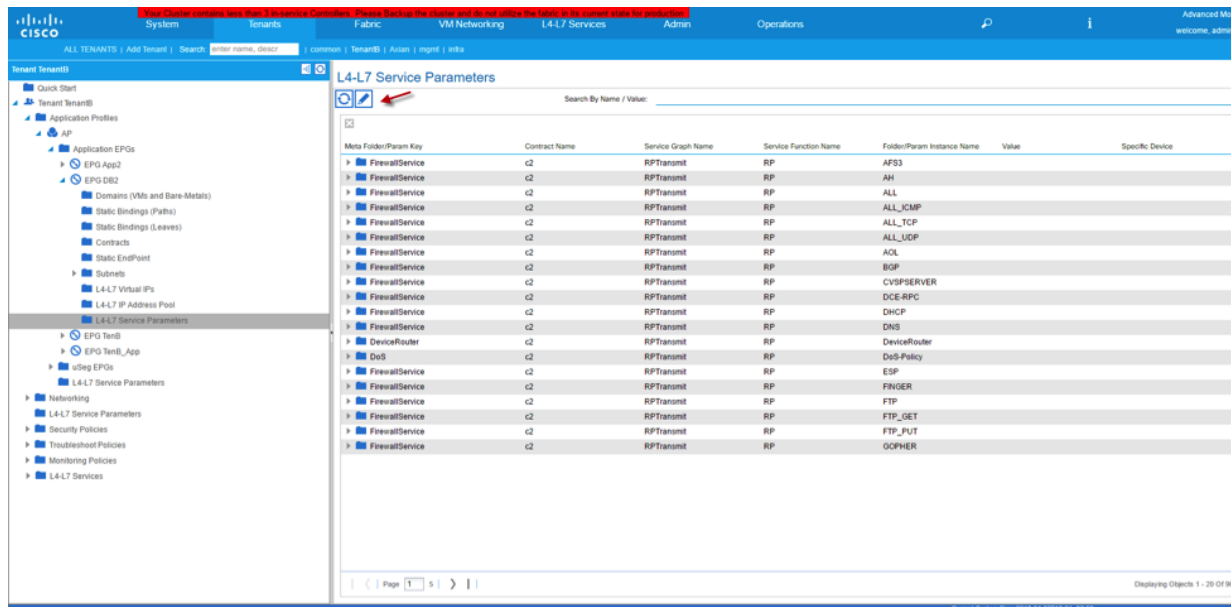
Once we combined the Firewall configuration and associated device together, we are ready to deploy the service Graph to create a VDOM automatically.



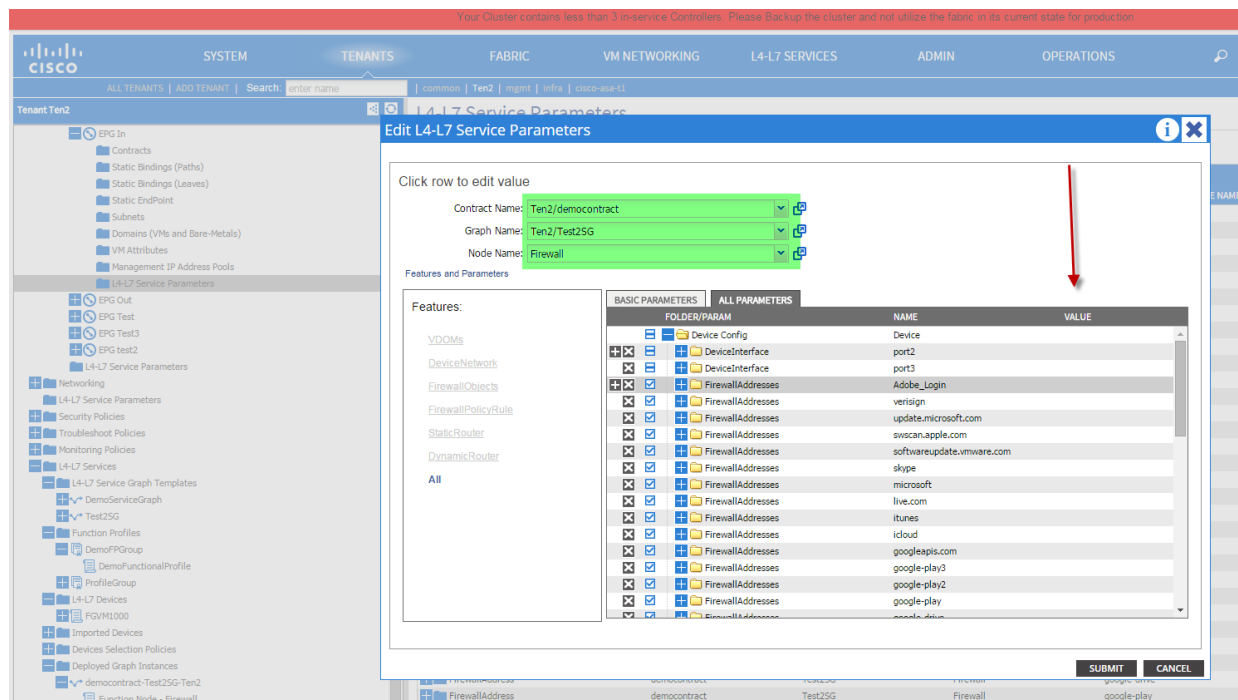
1. Right Click on Service Graph defined from above and select **Apply L4-L7 Service Graph Template**.

## Modify Service Graph

1. Navigate to **Tenant>Provider EPG>L4-L7 Service Parameters** and select the pen icon, which will lead you into edit mode to modify parameters on deployed Service Graph.

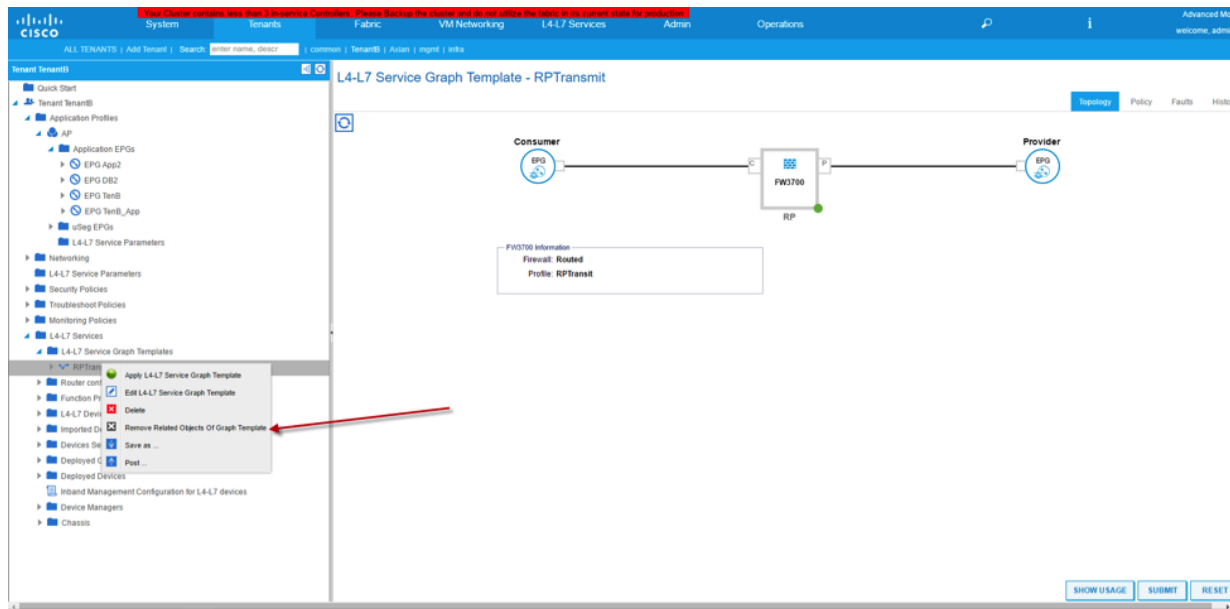


2. On the next screen, select the Contract name, Graph Name and Node name from the drop down list and all the associated Service Graph Parameters will be displayed.
3. Expand the field you want to make modification and change the appropriate value from the drop down list and then hit submit.



## Remove Service Graph

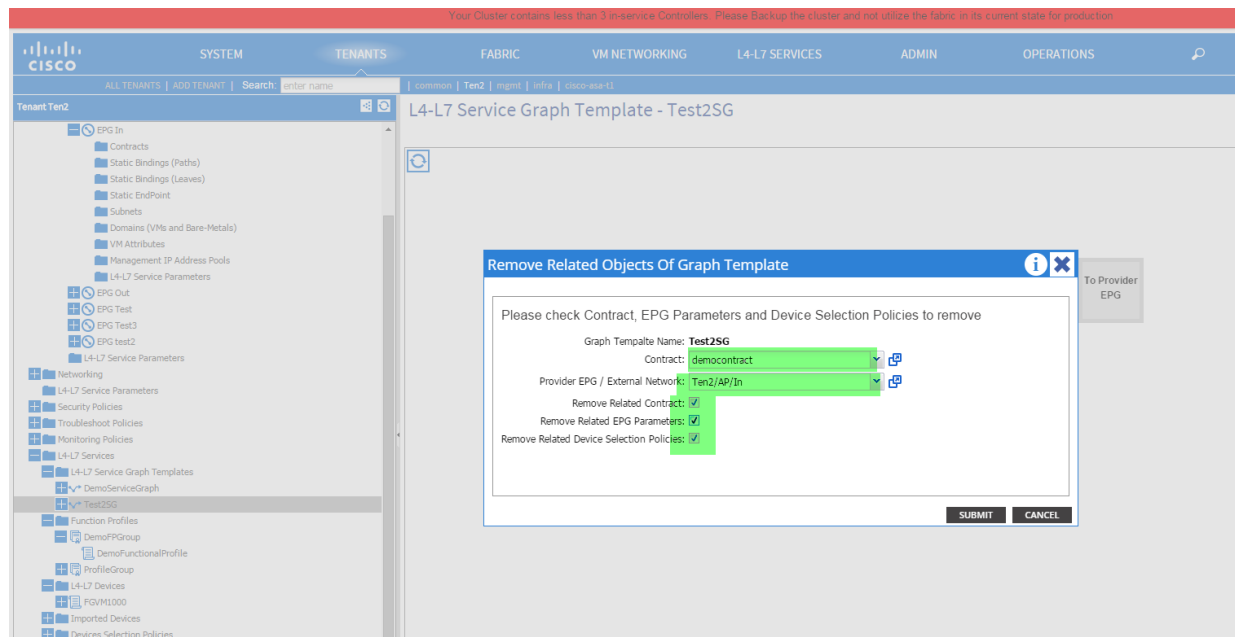
1. Navigate to **Tenant>L4-L7 Services>L4-L7 Service Graph Templates**. Right click on Service Graph template and select **Remove Related Objects Of Graph Template**.



2. Select **Contract and Provider EPG** from the drop down list and check all 3 boxes:

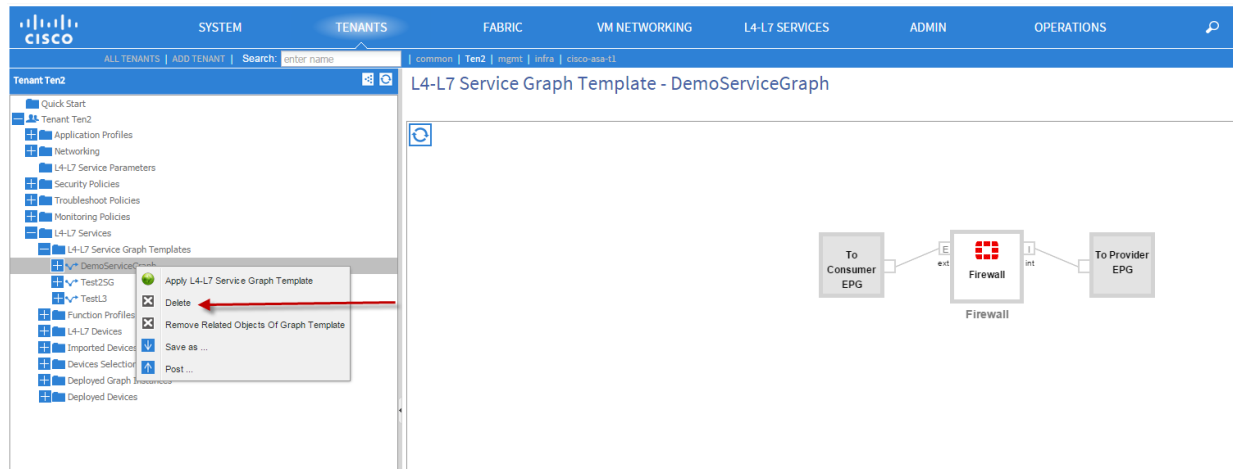
- **Remove Related Contract**
- **Remove Related EPG Parameters**
- **Remove Related Device Selection Policies**

Hit **Submit**. This will remove all the related objects for this Service Graph.



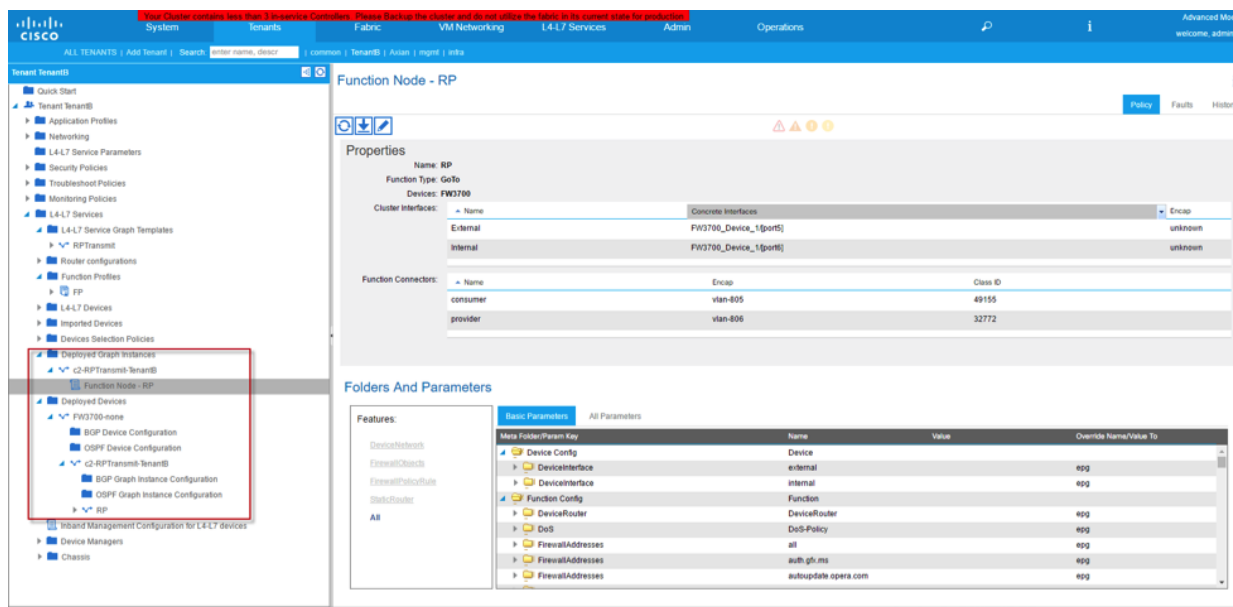
## Delete the Service Graph

1. To delete the Service Graph Template, navigate to **Tenant > L4-L7 Services > L4-L7 Service Graph Templates**.
2. Right click on template name listed on the left hand panel and select **Delete** option.



## Service Graph deployed

Once the service graph is deployed, the Fortigate device will receive configuration through REST API commands from the Cisco APIC. Below figure shows a successful service graph deployment. The Interface configuration such as vlan, IP..etc and firewall policies are all being programmed onto the Fortigate. From this point forward, any update is continue to be manage by Cisco APIC until the service graph is remove.



# Installation Variations

## Deploying Data Center Layer 2 Segmentation with Cisco ACI and FortiGate

### Pre-requisites

- Fabric Access Policies creation relating to
  - Vlan Pools
  - Domain
  - Attachable Access Entity Profiles
  - Interface Policies
  - Switch policies
- Create Tenant, VRF, 2 Bridge Domains, 2 EPGs
- Associate 2 Bridge Domains to VRF
- Associate 2 EPGs to the 2 Bridge Domains
- Layer 4-7 Device Package has imported into Cisco APIC

### Work Flow:

1. Create L4-L7 Device with Go-through Mode
2. Create Functional Profile
3. Create Service Graph Template
4. Deploy Service Graph

## Create L4-L7 Device with Go-Through mode on Cisco APIC

The screenshot shows the Cisco APIC GUI with the 'L4-L7 Services' tab selected. The left sidebar shows the navigation tree with 'L4-L7 Services' and 'L4-L7 Devices' highlighted. The main panel displays the configuration for 'L4-L7 Devices - FW3700L2'.

**General**

- Managed: ☒
- Name: FW3700L2
- Device Package: Fortinet-FGAPIC-1.2
- Service Type: Firewall
- Device Type: PHYSICAL
- Physical Domain: F3Domain
- Content Aware: Multiple
- Function Type: GoThrough (selected)
- Cluster Mode: Single Node

**Credentials**

- Username: admin
- Password: (masked)
- Confirm Password: (masked)

**Configuration State**

- Configuration Issues: (none)
- Devices State: stable

**Device 1**

- Management IP Address: 10.160.11.19
- Management Port: 443
- Chassis: (select a value)

**Interfaces**

Name	Path
port7	Node-101web1/10
port8	Node-102web1/10

**Cluster**

- Management IP Address: 10.160.11.19
- Management Port: 443
- Device Manager: (select a value)

**Cluster Interfaces**

Type	Name	Concrete Interfaces
provider	g2_ins	FW3700L2_Device_1(port8)
consumer	g2_out	FW3700L2_Device_1(port7)
provider	ins	FW3700L2_Device_1(port8)

Buttons at the bottom: SHOW USAGE, SUBMIT, RESET.

## Create Functional Profile

Functional Profile defines the template for the Service(s) that is going to deploy, such as L4-L7 Device Interface IP addresses, Rule ID, Object Addresses, Policy Rules, Source/Destination Ports...etc.

The screenshot shows the Cisco APIC GUI with the 'L4-L7 Services' tab selected. The left sidebar shows the navigation tree with 'L4-L7 Services' and 'L4-L7 Services Function Profile Group - FP' highlighted. The main panel displays the configuration for 'L4-L7 Services Function Profile Group - FP'.

**Properties**

- Name: FP
- Description: (empty)

**Service Function Profiles**

Name	Associated Function	Description
RPTtransit	Firewall	

Buttons at the bottom: GENERAL, FAULTS, HISTORY.

## Functional Profile Objects Explanation under “Features”:

### Device Network

Contained External and Internal Interfaces that will be programmed onto Fortigate VDOM. This is the interfaces (typically external and internal) that will be associated to the VDOM. If user intends to have multiple legs deployment scenario, this is where he/she can add additional interfaces with unique name.



User must leave IP address field untouched in Go-through mode.

### Firewall Objects

This field allows user to customize Firewall Addresses, Service and scheduling.

### Firewall Policy Rule

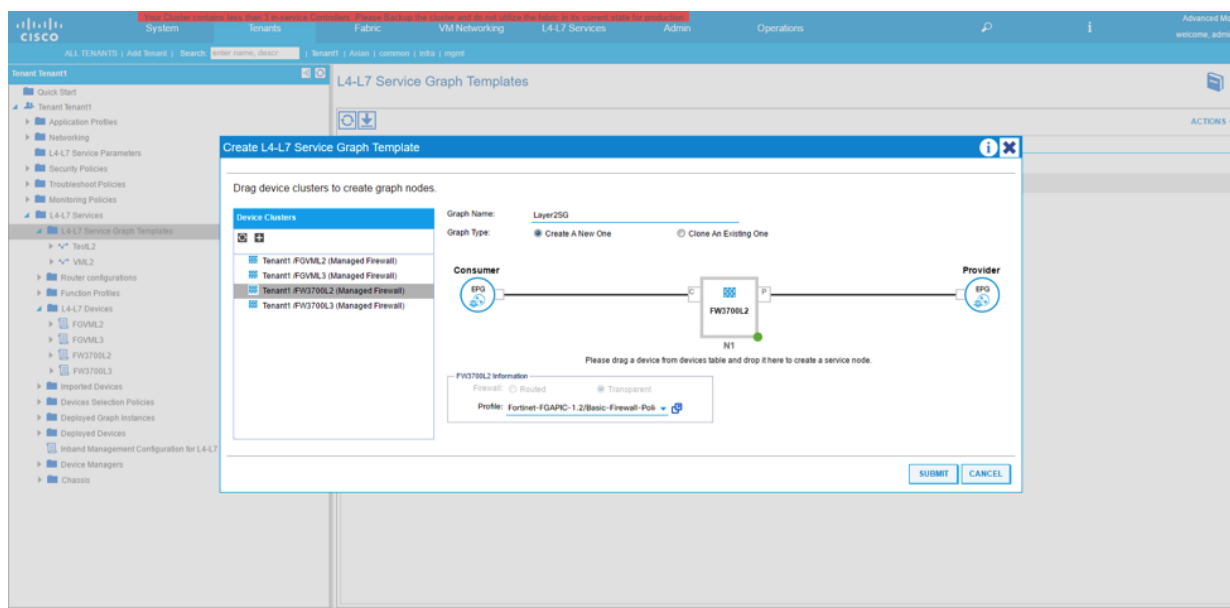
This field encompassed the creation of Firewall policy that will be program onto Fortigate. Security Profile and Logging Options are also configured here.

### All

This field listed all the parameters stated above plus DDOS configuration.

## Create Service Graph

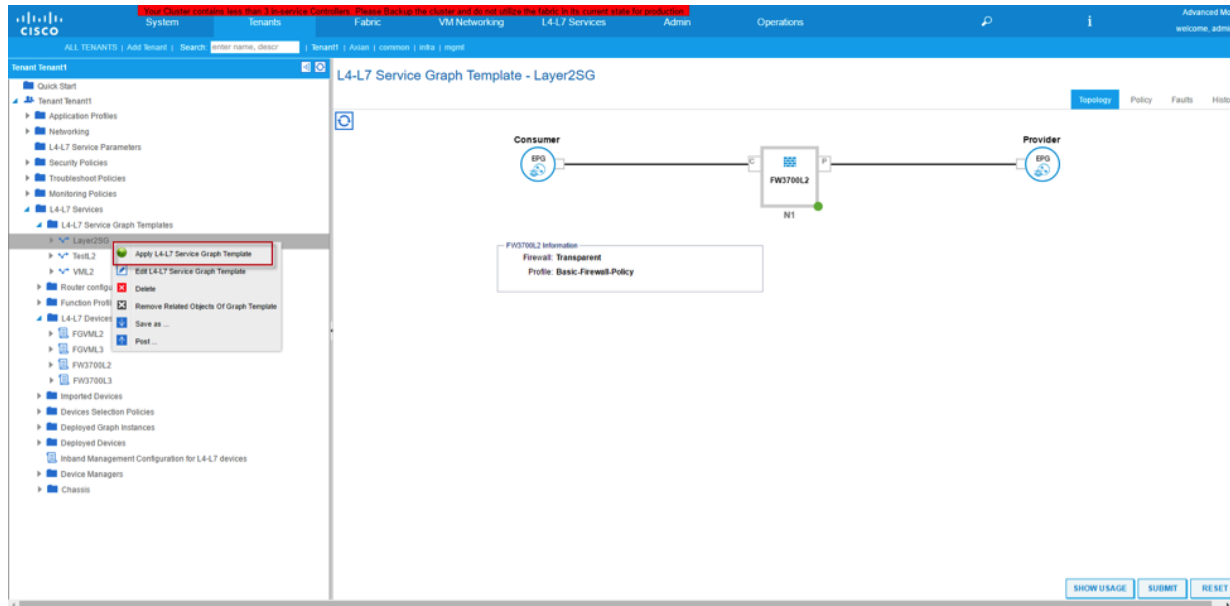
Service Graph template is used to tightly coupled the Functional Profile or Firewall configuration and combine with the Firewall device we defined at earlier steps.



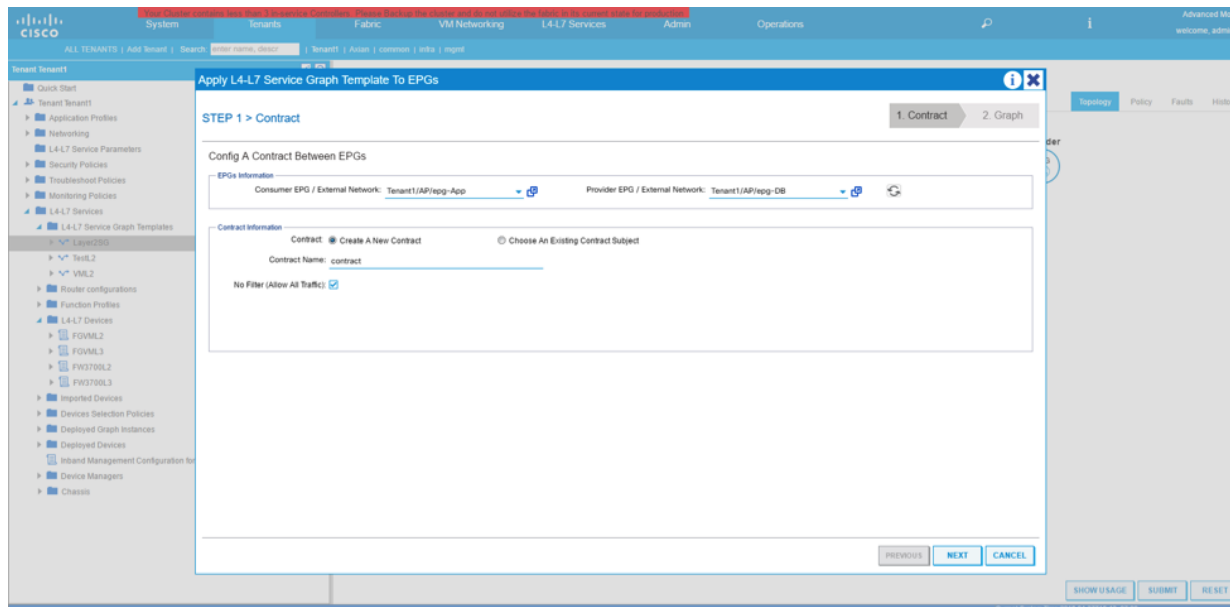


## Deploy Service Graph

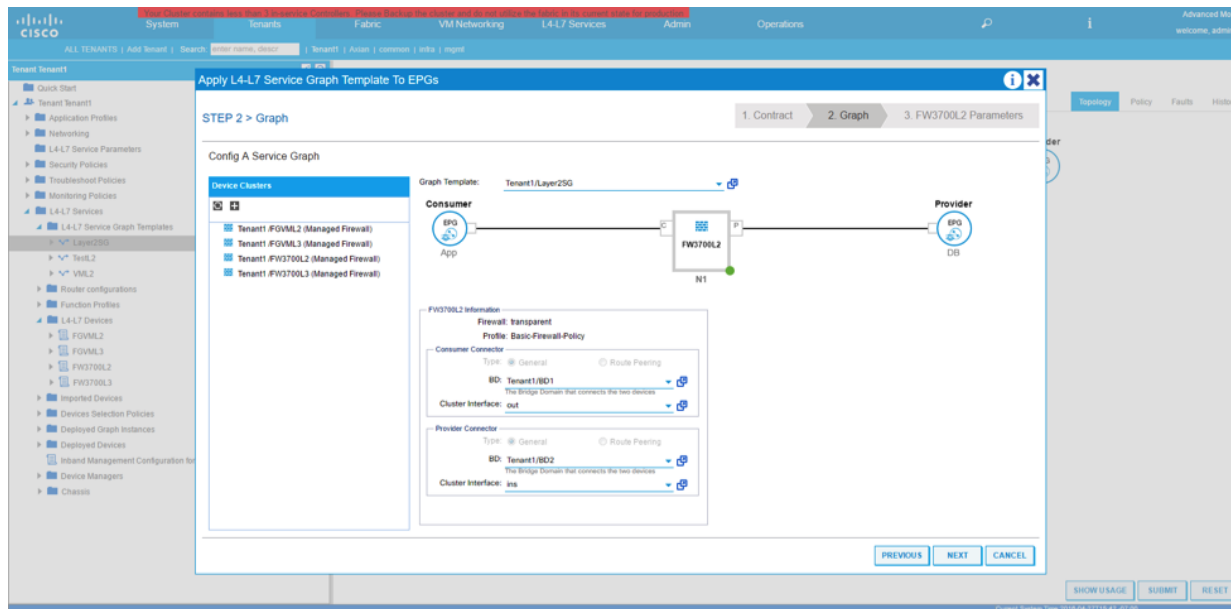
Once we combined the Firewall configuration and associated device together, we are ready to deploy the Service Graph.



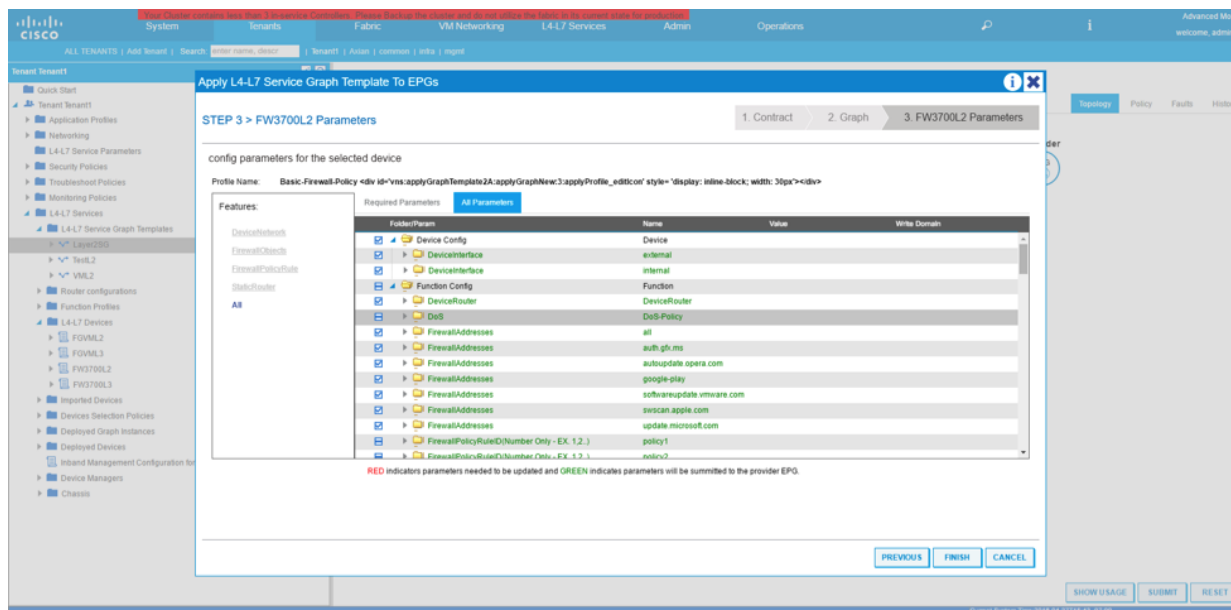
On next screen select the Consumer and Provider EPGs and assign a contract name or select a pre-define contract.



Next screen select the logical interfaces defined during the creation of L4-L7 Device.

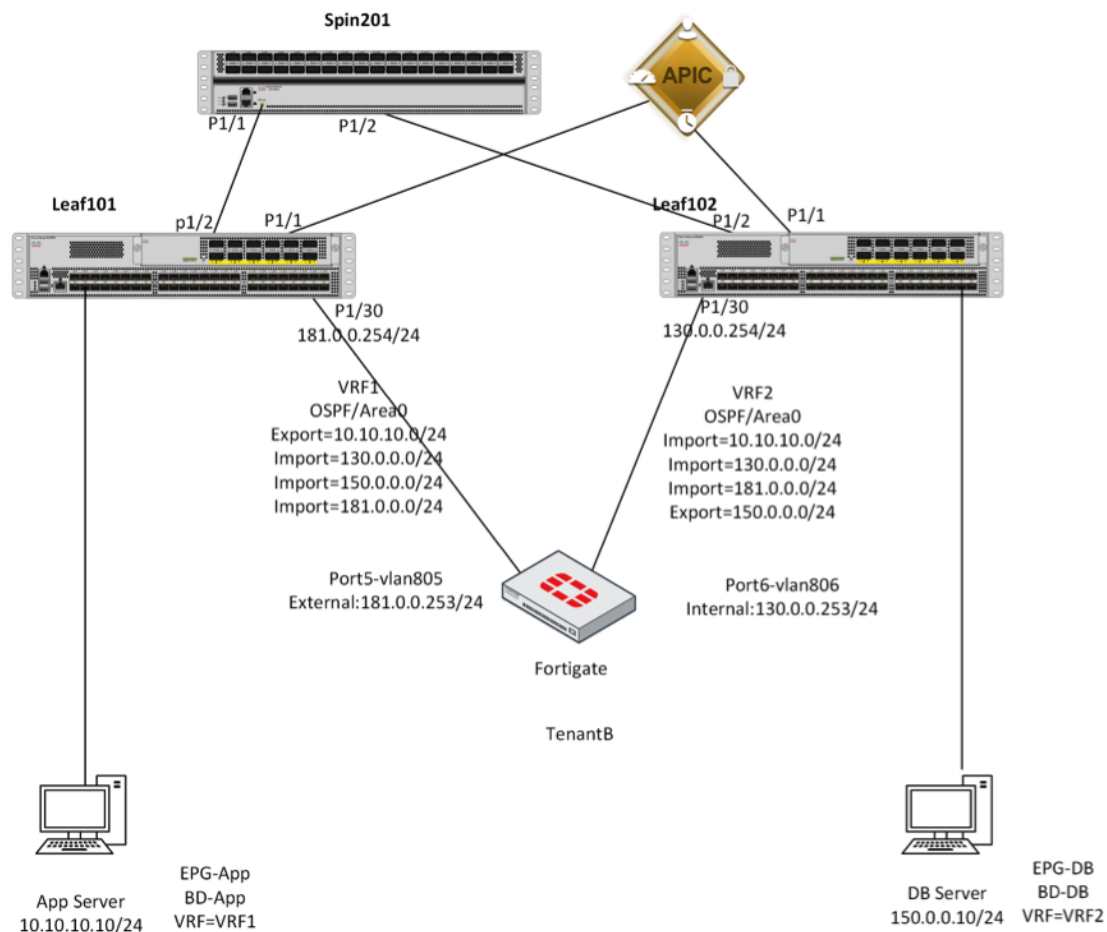


Next screen is the last minute to validate all configurations before deploy, then hit the submit button.



## Deploying Data Center Layer 3 Segmentation with Cisco ACI and FortiGate

### L3 Segmentation Topology



### Introduction:

This document describes the configuration walk through of L4-L7 Service Graph with L3 Segmentation within Data Center.

### Prerequisites:

Please pre-configure below configuration before deploying this design:

- Fabric Access Policies creation relating to:
  - VLAN Pools
  - Domain

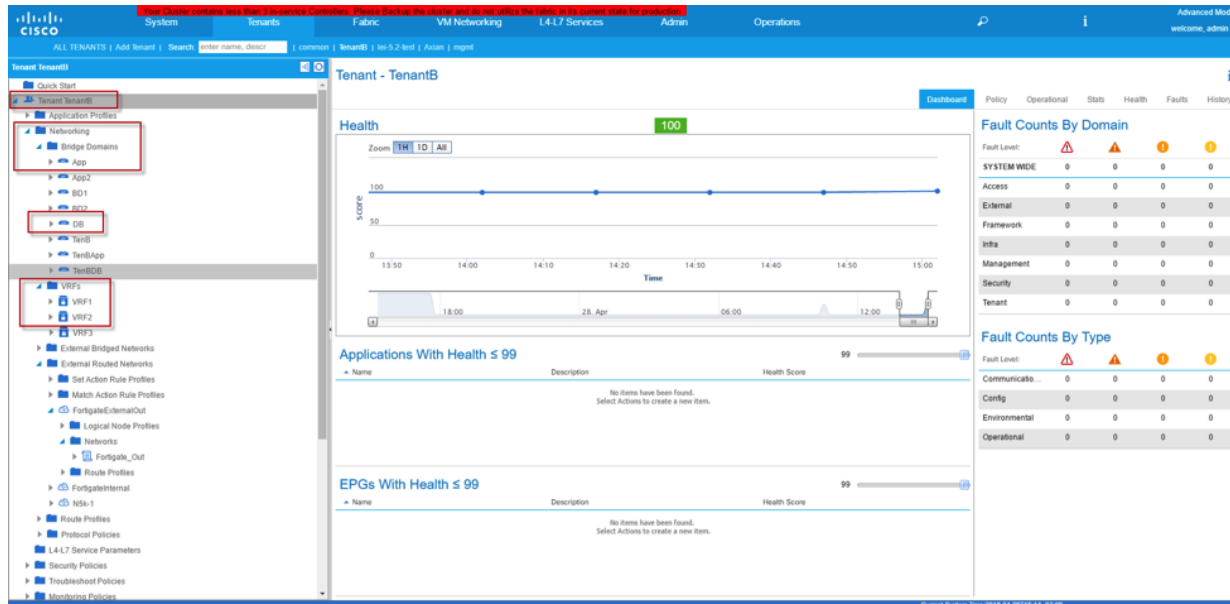
- Attachable Access Entity Profiles
- Interface Policies
- Switch Policies
- L4-L7 Device Package has imported into Cisco APIC

### Work Flow:

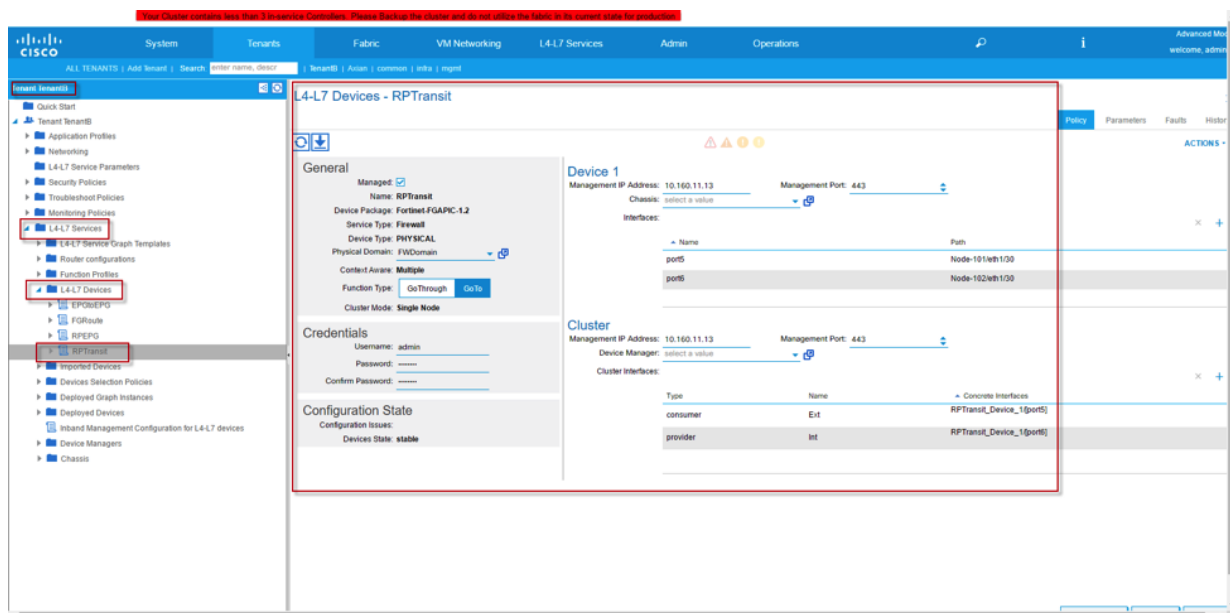
1. Create Tenant (TenantB in our example)
2. Create VRFs (VRF1 and VRF2 in our example)
3. Create Bridge Domains and map to VRFs ( Bridge Domain App and DB are mapped to VRF1 and VRF2 respectively in our example)
4. Create EPGs and map to Bridge Domains (EPG-DB and EPG-App in our example)
5. Create two L3Out EPGs (1 for Firewall External and 1 for Firewall Internal. In our example, we created “FortigateExternalOut” for Firewall External and “FortigateInternal” for Firewall Internal)
6. Configure gateway IPs on Bridge Domains (DB and App) for App and DB Servers
7. Ensure “Unicast Routing” is checked in each Bridge Domain
8. In Bridge Domain App, associate L3Outs to “FortigateExternalOut”; in Bridge Domain DB, associate L3Outs to “FortigateInternal”
9. Map App and DB machines to EPGs and configure correct IP addresses, and use Bridge Domain IP address (configured in step 6) as its gateway
10. Verify App and DB machines can ping to gateway IP address
11. Create L4-L7 Device with GoTo mode
12. Create Functional Profile Group as well as Functional Profile
13. Create Route Profiles
14. Create L4-L7 Service Graph Template
15. Deploy L4-L7 Service Graph

## Configuration:

**Configure the Bridge Domain DB and App as well as VRF1 and VRF2. Associate Bridge Domain App to VRF1 and Bridge Domain DB to VRF2.**



**Configure L4-L7 Device for physical Fortigate (GoTo Mode)**



## Configure L3Out for Fortigate External Interface and associate with VRF1

**Properties**

Tags:

Label:

Target DSCP: unspecified

Route Control Enforcement: ☐ Import ☐ Export

VRF: TenantB/VRF1

Resolved VRF: TenantB/VRF1

External Routed Domain: Internet

Route Profile for Interleaf: select a value

Route Control For Dampening:

Address Family Type:

Route Dampening Policy: No items have been found. Select Actions to create a new item.

Enable BGP/EGRP/OSPF: ☐ BGP ☒ OSPF ☐ EIGRP

OSPF Area ID: 0

OSPF Area Cost: 1

OSPF Area Type: ☒ NSSA area ☒ Regular area ☐ Stub area

OSPF Area Cost: 1

SHOW USAGE SUBMIT RESET

## Configure SVI for L3Out Fortigate External out

, ND policy: select a value, Egress Data Plane Policing Policy: select a value, Ingress Data Plane Policing Policy: select a value, and Routed interfaces table."/>

**Properties**

Name: ExternalIP

Description: optional

Label:

ND policy: select a value

Egress Data Plane Policing Policy: select a value

Ingress Data Plane Policing Policy: select a value

Routed interfaces:

Path	IP Address	MAC Address	MTU (Bytes)
No items have been found. Select Actions to create a new item.			

SVI:

Path	IP Address	Side A IP	Side B IP	MAC Address	MTU (Bytes)	Encap
Node101eth1/0/0	181.0.0.254/24			00:22:8D:FB:19:FF	9000	vlan-805

Routed Sub-interfaces:

Path	IP Address	MAC Address	MTU (Bytes)	Encap
No items have been found. Select Actions to create a new item.				

## Configure Route ID for L3Out Fortigate External Out

The screenshot shows the Cisco ACI GUI with the 'Logical Node Profile - ExternalNP' configuration page. The left sidebar shows the navigation tree with 'Logical Node Profiles' selected. The main panel displays the 'Properties' section for 'ExternalNP'. The 'Nodes' table is highlighted with a red box, showing the following data:

Node ID	Route ID	Static Routes	Endpoint Address
topology/pod-1/node-101	101.0.0.105		101.0.0.105

## Configure Import/Export Route Control on Subnets for Fortigate External out

The screenshot shows the Cisco ACI GUI with the 'External Network Instance Profile - Fortigate\_Out' configuration page. The left sidebar shows the navigation tree with 'External Network Instance Profiles' selected. The main panel displays the 'Properties' section for 'Fortigate\_Out'. The 'Subnets' table is highlighted with a red box, showing the following data:

IP Address	Scope	Aggregate	Route Control Profile	Route Summarization Policy
10.10.10.0/24	Export Route Control Subnet			
130.0.0.0/24	External Subnets for the External EPG			
150.0.0.0/24	External Subnets for the External EPG			
181.0.0.0/24	External Subnets for the External EPG			
192.168.1.0/30	Export Route Control Subnet			

## Configure L3Out for Fortigate Internal and associate with VRF2

**Properties**

Tags:

Label:

Target DSCP: unspecified

Route Control Enforcement: ☐ Import ☒ Export

VRF: TenantB/VRF2

Resolved VRF: TenantB/VRF2

External Routed Domain: Internet

Route Profile for Interleaf:

Route Control For Dampening:

Address Family Type:

Route Dampening Policy:

Enable BGP/EGRP/OSPF: ☐ BGP ☒ OSPF

OSPF Area ID: 0

OSPF Area Control: ☒ Send redistributed LSAs into NSSA area ☒ Originate summary LSA ☐ Suppress forwarding address in translated LSA

OSPF Area Type:  NSSA area  Regular area  Stub area

OSPF Area Cost: 1

SHOW USAGE SUBMIT RESET

## Configure SVI for L3Out Fortigate Internal

**Properties**

Name: FortigateInternalIP

Description: optional

Label:

ND policy:

Egress Data Plane Policing Policy:

Ingress Data Plane Policing Policy:

Routed interfaces:

Path	IP Address	MAC Address	MTU (Bytes)
No items have been found. Select Actions to create a new item.			

SVI:

Path	IP Address	Side A IP	Side B IP	MAC Address	MTU (Bytes)	Encap
Node-1024eth1/0/0	130.0.0.254/24			00:22:8D:F8:19:FF	9000	vlan-806

Routed Sub-interfaces:

Path	IP Address	MAC Address	MTU (Bytes)	Encap
No items have been found. Select Actions to create a new item.				



## Configure Route ID for L3Out Fortigate Internal

The screenshot shows the Cisco ACI Tenant Portal interface. The left sidebar displays the navigation tree with the following structure:

- Tenant: Tenant1
- Network Profiles
  - Bridge Domains
  - VRFs
  - External Bridged Networks
  - External Routed Networks
    - Set Action Rule Profiles
    - Match Action Rule Profiles
    - FortigateExternalOut
    - FortigateInternal** (highlighted)
    - Logical Interface Profiles
      - FortigateInternalIP
      - OSPF Interface Profile
    - Configured Nodes
      - Networks
        - Fortigate\_In
        - Route Profiles** (highlighted)
          - N5k-1
          - N5k-2
      - Route Profiles
      - Protocol Policies
      - L4-L7 Service Parameters
      - Security Policies
      - Troubleshoot Policies
      - Monitoring Policies
      - L4-L7 Services

The main panel displays the 'Logical Node Profile - FortigateInternal\_NP' configuration. The 'Properties' section includes:

- Name: FortigateInternal\_NP
- Description: optional
- Label: (empty field)
- Target DSCP: unspecified
- Nodes: (empty table)

The 'Nodes' table is currently empty. The bottom of the page shows the system time: 2018-04-09T14:22:07-08.

## Configure Import/Export Route Control on Subnet for L3Out Fortigate Internal

The screenshot shows the Cisco ACI Tenant Portal interface. The left sidebar displays the navigation tree with the following structure:

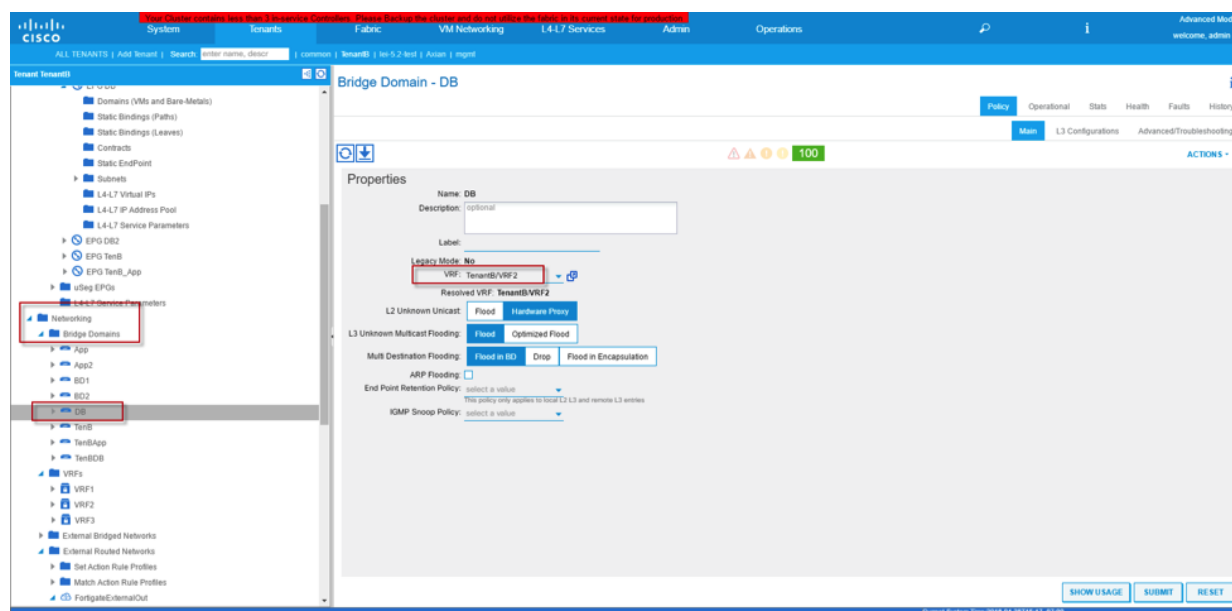
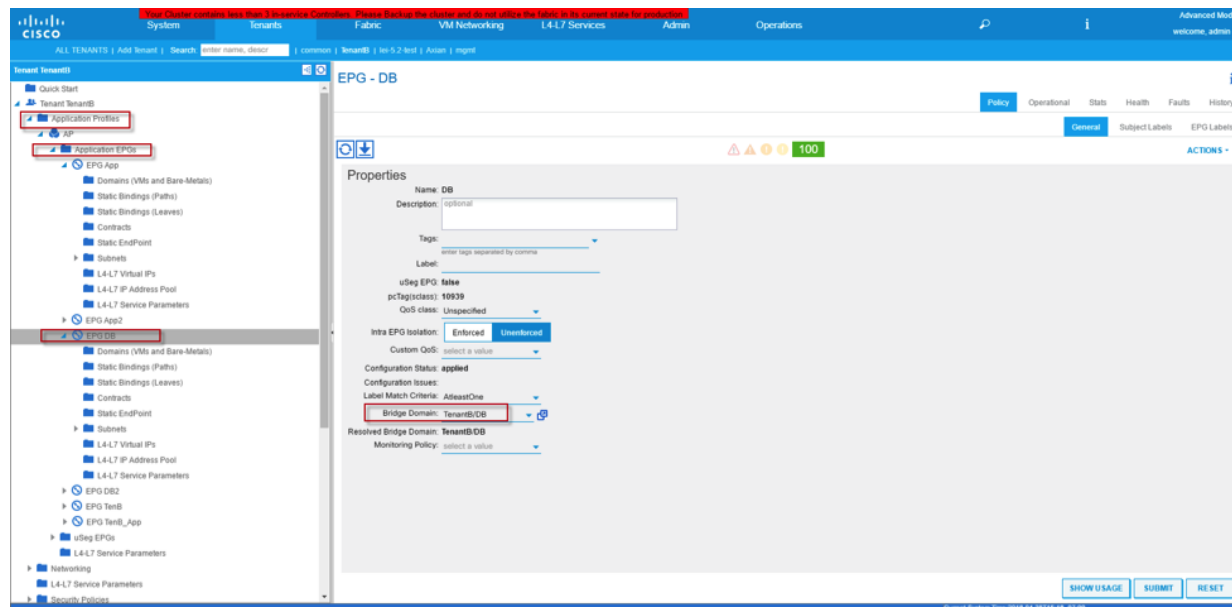
- Tenant: Tenant1
- Network Profiles
  - Bridge Domains
  - VRFs
  - External Bridged Networks
  - External Routed Networks
    - Set Action Rule Profiles
    - Match Action Rule Profiles
    - FortigateExternalOut
    - FortigateInternal
    - Logical Interface Profiles
      - FortigateInternalIP
      - OSPF Interface Profile
    - Configured Nodes
      - Networks
        - Fortigate\_In
        - Route Profiles** (highlighted)
          - N5k-1
          - N5k-2
      - Route Profiles
      - Protocol Policies
      - L4-L7 Service Parameters
      - Security Policies
      - Troubleshoot Policies
      - Monitoring Policies
      - L4-L7 Services

The main panel displays the 'External Network Instance Profile - FortInternal' configuration. The 'Properties' section includes:

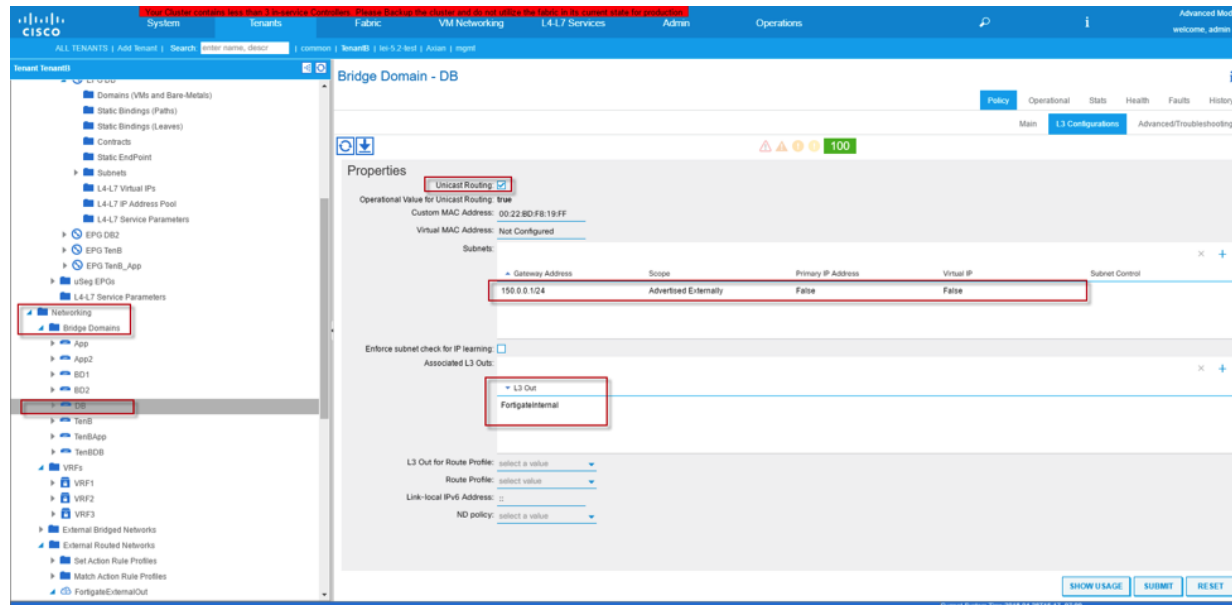
- Name: FortInternal
- Tags: (empty field)
- Description: optional
- Configured VRF name: VRF2
- Resolved VRF: tenant1-Tenant1-VRF2
- Target DSCP: unspecified
- Configuration Status: applied
- Configuration Issues: (empty list)

The 'Route Control' table is currently empty. The bottom of the page shows the system time: 2018-04-09T14:22:07-08.

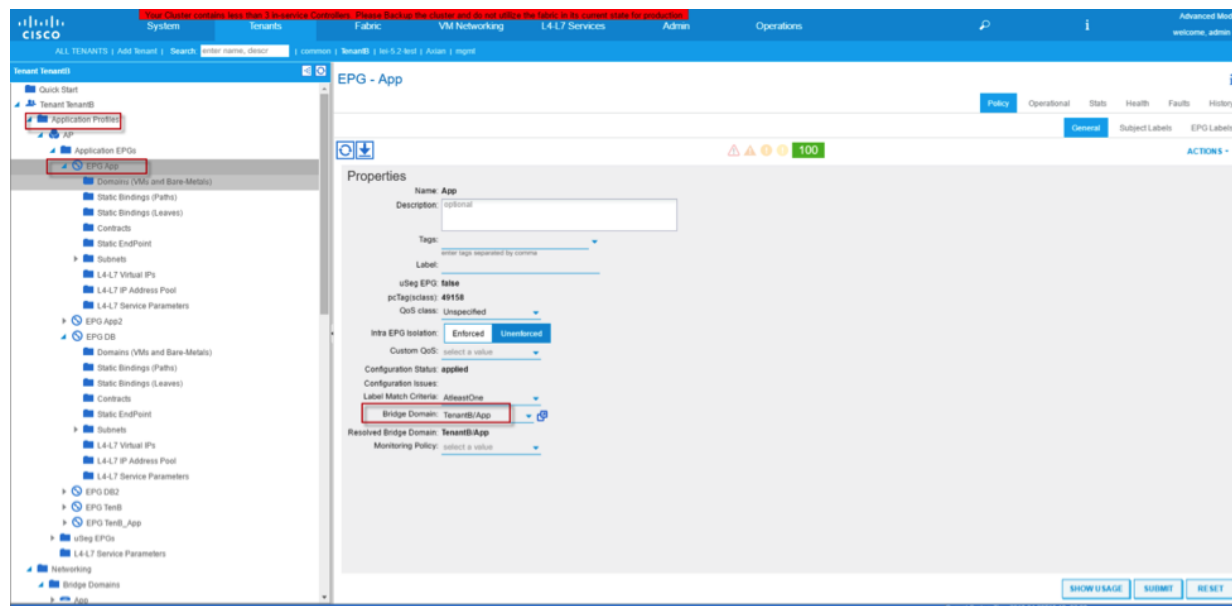
## Associate EPG “DB” to Bridge Domain “DB” and attach Bridge Domain to VRF2

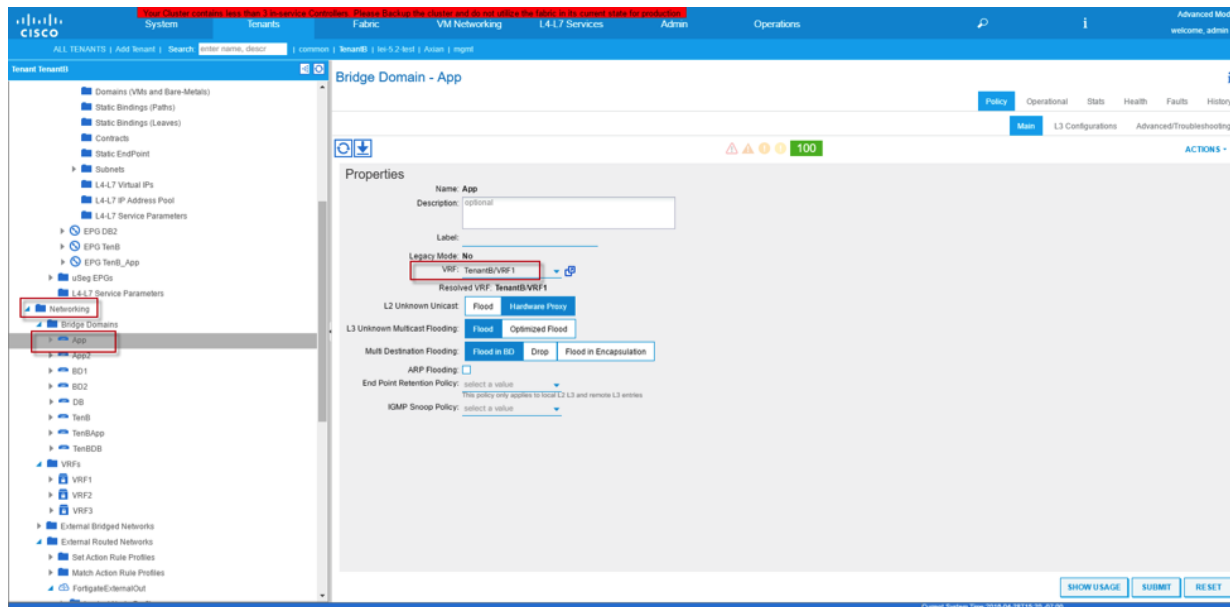


## Configure Bridge Domain with Unicast Routing, assign SVI and associate L3Out to “FortigateInternal”

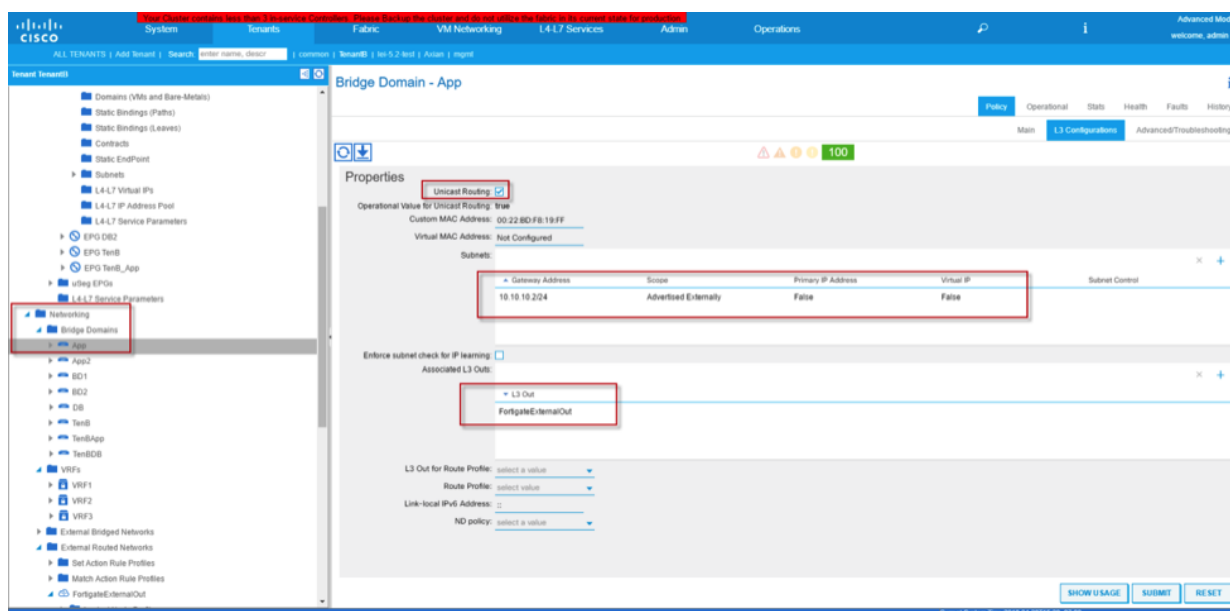


## Associate EPG “App” to Bridge Domain “App” and attach Bridge Domain to VRF1

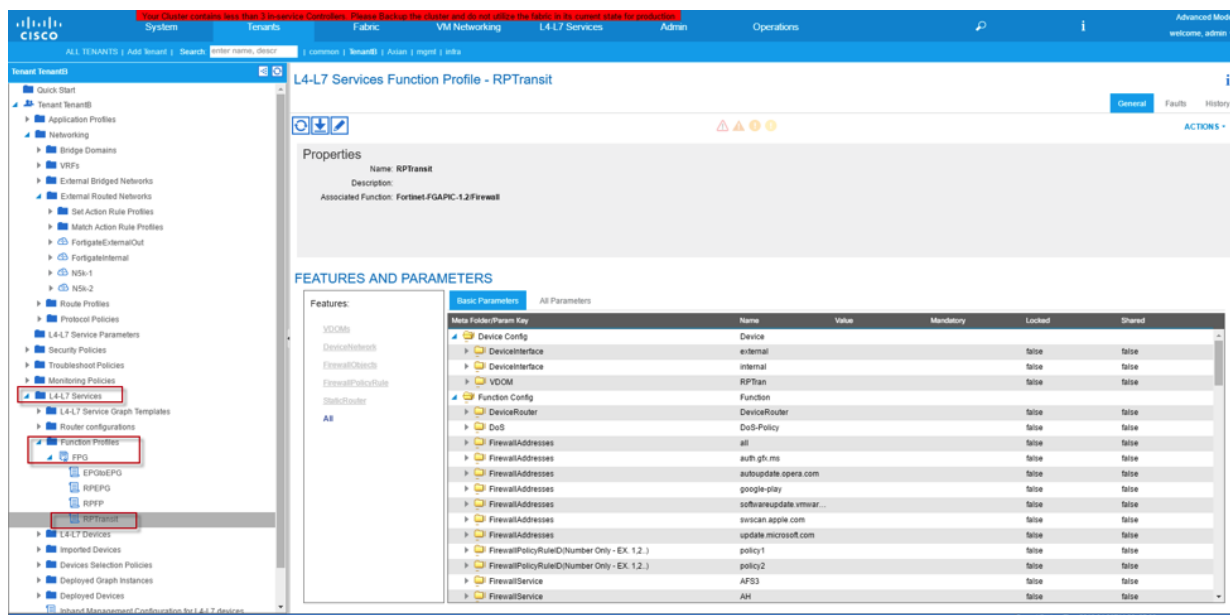
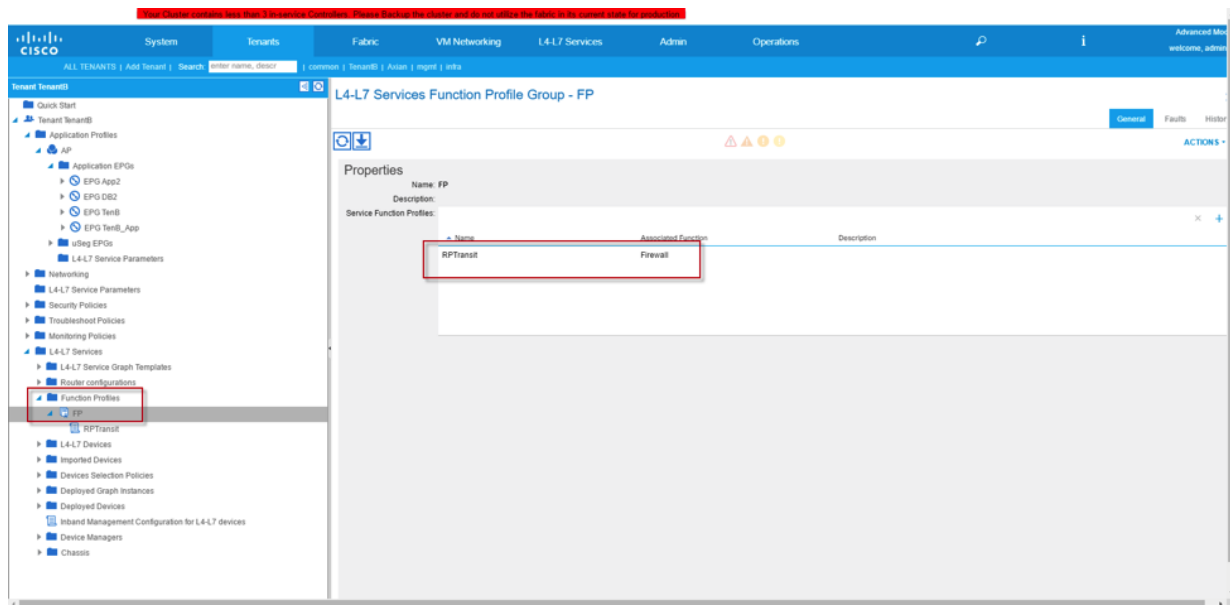




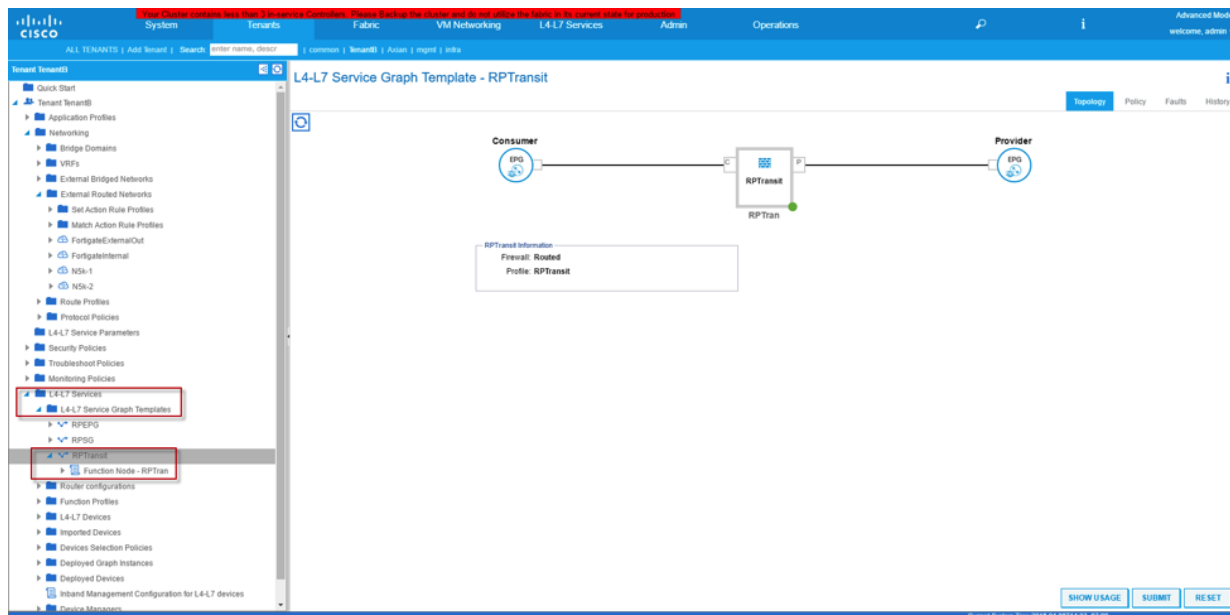
## Configure Bridge Domain with Unicast Routing, assign SVI and associate L3Out to “FortigateInternal”



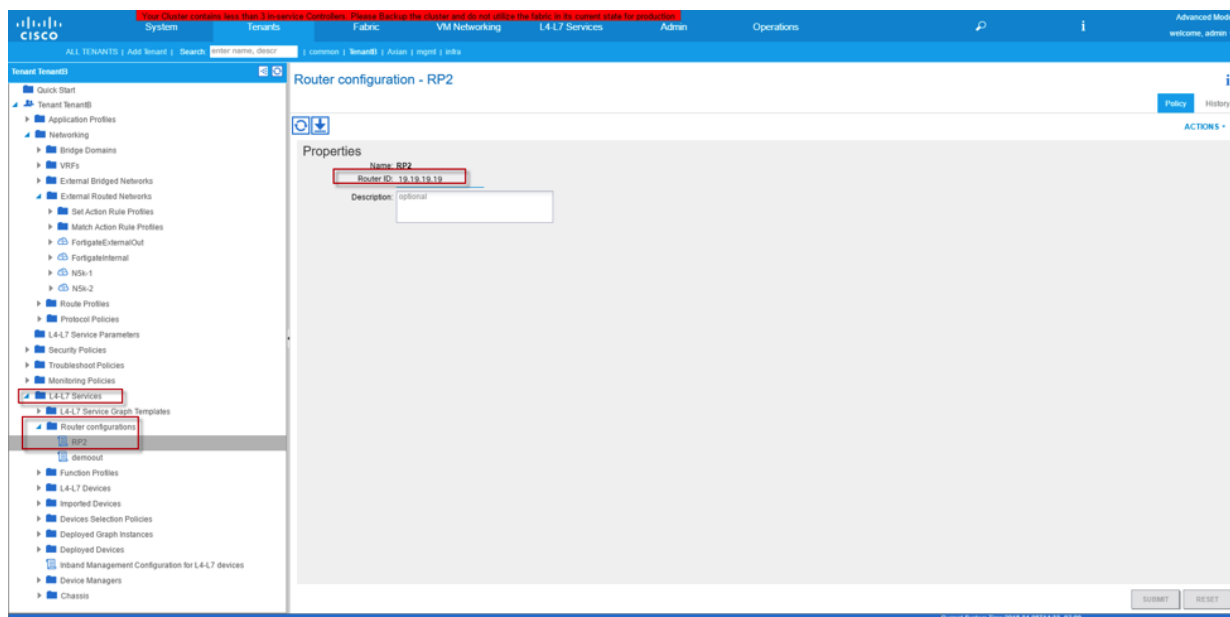
## Create Functional Profile Group and Functional Profile from existing template



## Create Service Graph template



## Create Router ID that will be used on the Service Appliance (Fortigate)



## Deploy Service Graph

Properties

Name: RPTransit  
Template Name: UNSPECIFIED  
Configuration Issues: optional

Label:

Name	Function Name	Function Type	Description
RPTran	FortinetFGAPIC-12Firewall	GoTo	

Name	Provider/Consumer	Description
T1	Consumer	
T2	Provider	

Name	Connected Nodes	Unicast Route	Adjacency Type	Description
C1	RPTran, T1	True	L3	
C2	RPTran, T2	True	L3	

SHOW USAGE SUBMIT RESET



Consumer will be App EPG. Provider is the DB EPG.

STEP 1 > Contract

1. Contract 2. Graph

Config A Contract Between EPGs

EPGs Information

Consumer EPG / External Network: TenantB/AP/epg-App

Provider EPG / External Network: TenantB/AP/epg-DB

Contract Information

Contract: Create A New Contract Choose An Existing Contract Subject

Contract Name: Contract

No Filter (Allow All Traffic) ☒

PREVIOUS NEXT CANCEL

SHOW USAGE SUBMIT RESET



Please select for Internal and external connections. In our example, we used “FortigateExternalOut” and FortigateInternal” as External and Internal selections respectively.

### Apply L4-L7 Service Graph Template To EPGs

#### STEP 2 > Graph

1. Contract 2. Graph 3. RPTransit Parameters

#### Config A Service Graph

Graph Template: TenantB/RPTransit

**Consumer**  
Fortigate\_Out

**Provider**  
Fortigate\_In

**RPTransit Information**

- Firewall: routed
- Profile: RPTransit
- Router Config: TenantB/RP2

**Consumer Connector**

- Type: General ☒ Route Peering
- L3 Ext Network: TenantB/FortigateExternalOut/Fortigate\_Out
- Cluster Interface: Ext

**Provider Connector**

- Type: General ☒ Route Peering
- L3 Ext Network: TenantB/FortigateInternal/Fortigate\_In
- Cluster Interface: Int

PREVIOUS NEXT CANCEL

Last minute check to make sure configuration is good before hit “Finish” button

System Tenants Fabric VM Networking L4/L7 Services Admin Operations

ALL TENANTS | Add Tenant | Search | TenantB | Action | Import | Info

### Apply L4-L7 Service Graph Template To EPGs

STEP 3 > RPTransit Parameters

config parameters for the selected device

Profile Name: RPTransit <div id="vns-applyGraphTemplate2A:applyGraphNew3:applyProfile\_editIcon" style="display: inline-block; width: 30px; height: 15px; border: 1px solid #ccc;">

**Features:**

Folder/Param	Name	Value	Write Domain
Device Config	Device		
DeviceInterface	external		
DeviceInterface	internal		
VDOM	RPTran		
Function Config	Function		
DeviceRouter	DeviceRouter		
DoS	DoS-Policy		
FirewallAddresses	all		
FirewallAddresses	auth-g5.ms		
FirewallAddresses	authupdate.opera.com		
FirewallAddresses	google-play		
FirewallAddresses	softwareupdate.vmware.com		
FirewallAddresses	swscan.apple.com		
FirewallAddresses	update.microsoft.com		
FirewallAddresses	update.microsoft.com		

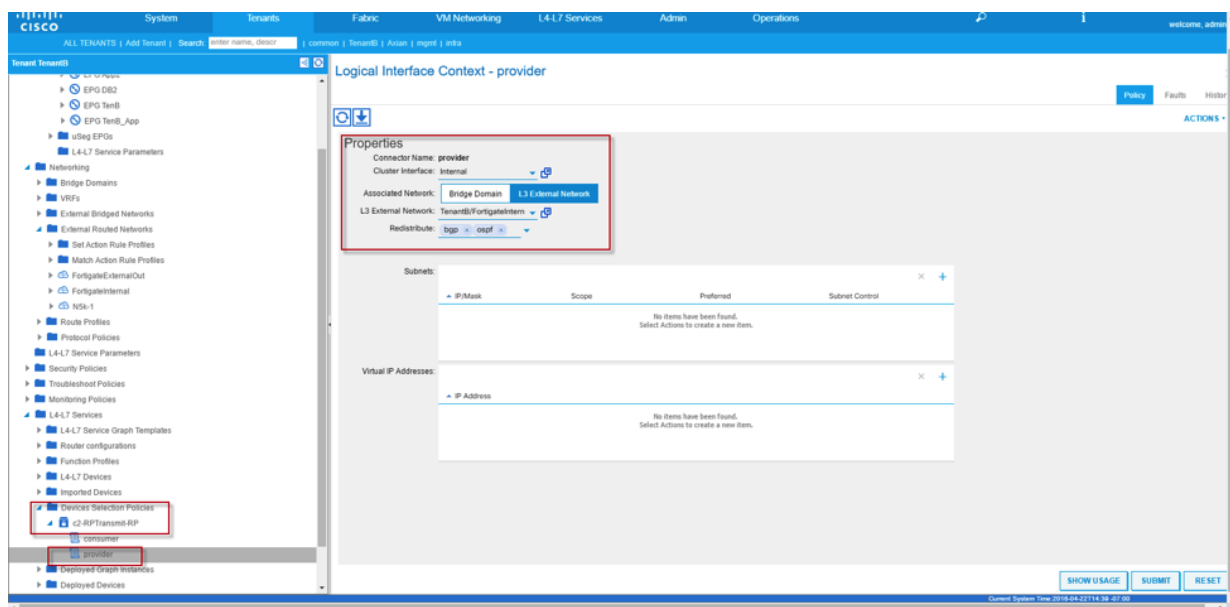
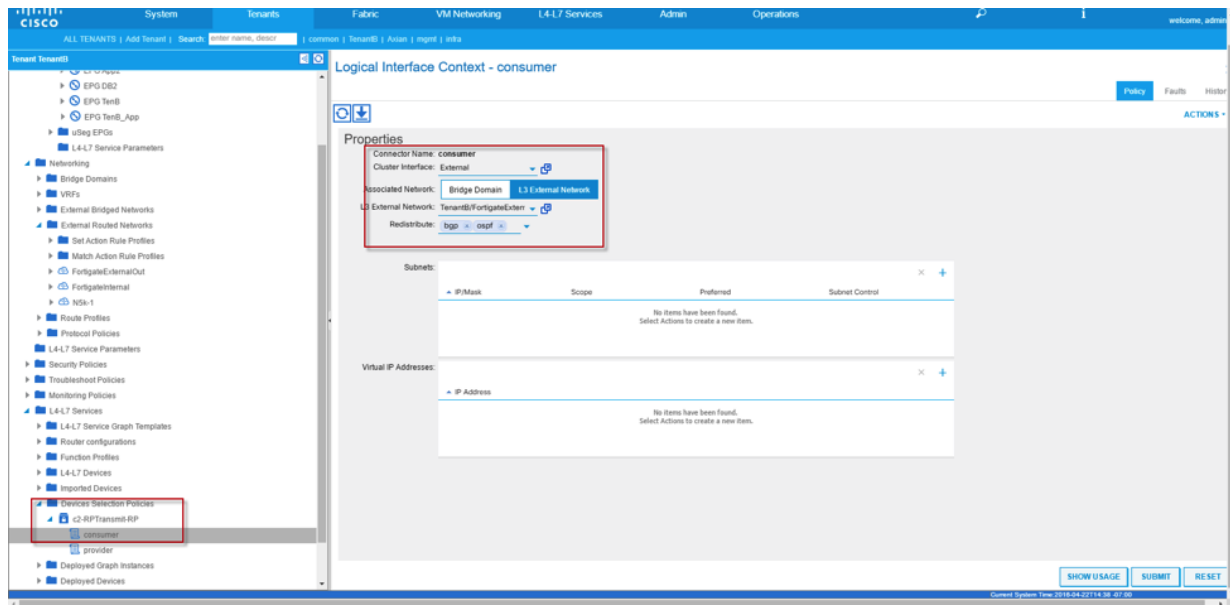
RED indicators parameters needed to be updated and GREEN indicates parameters will be submitted to the provider EPG.

PREVIOUS **FINISH** CANCEL

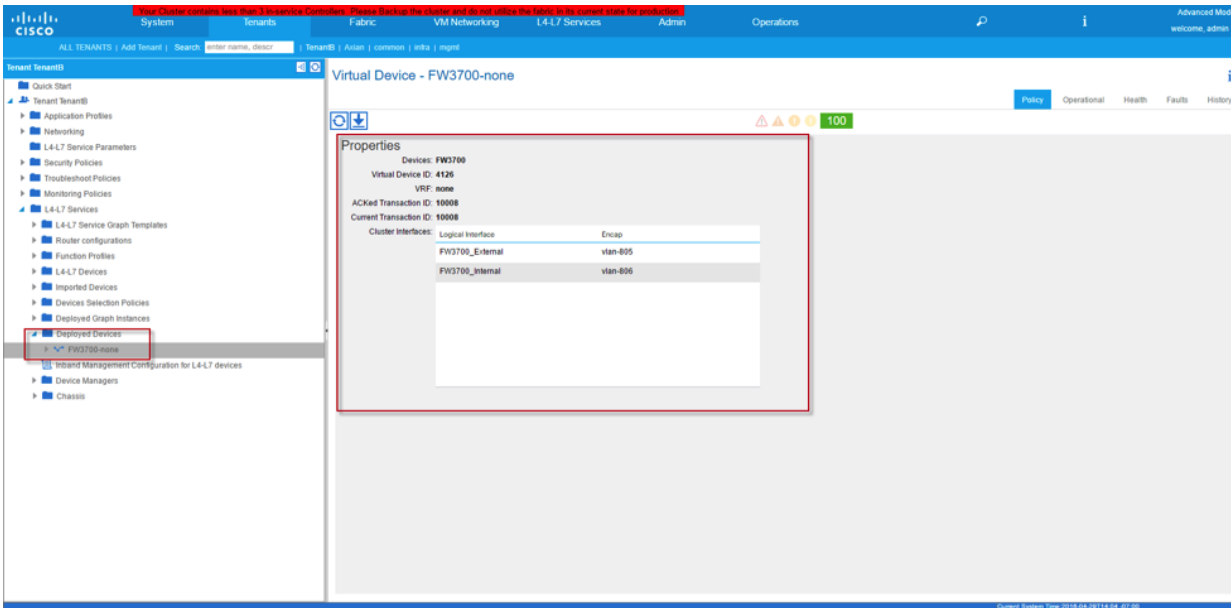
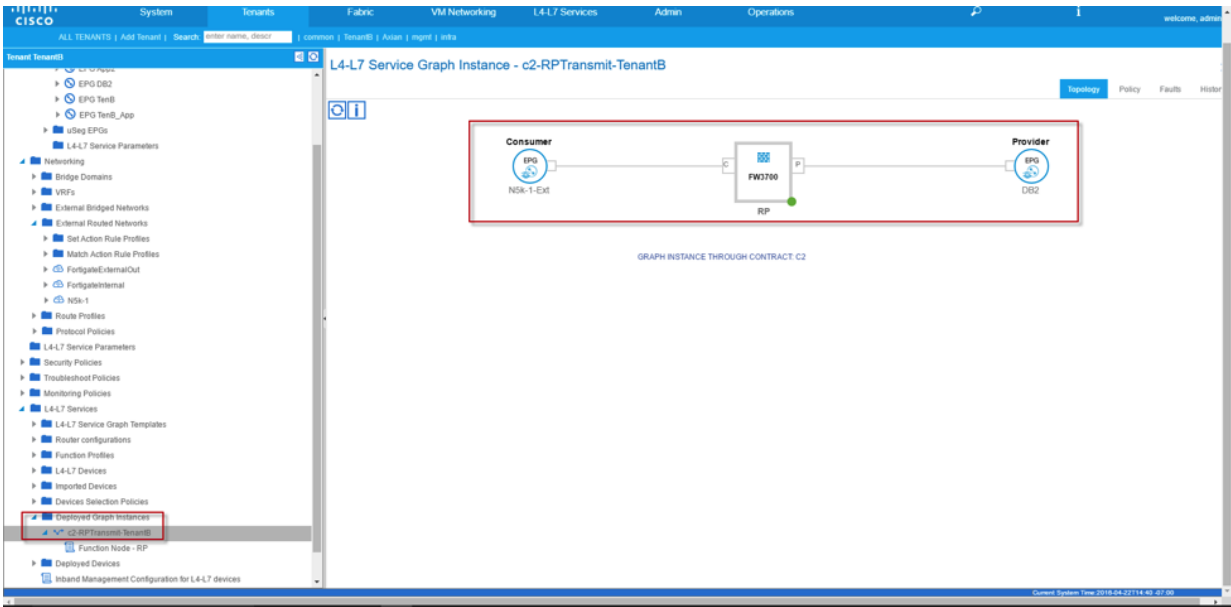
SHOW USAGE SUBMIT RESET



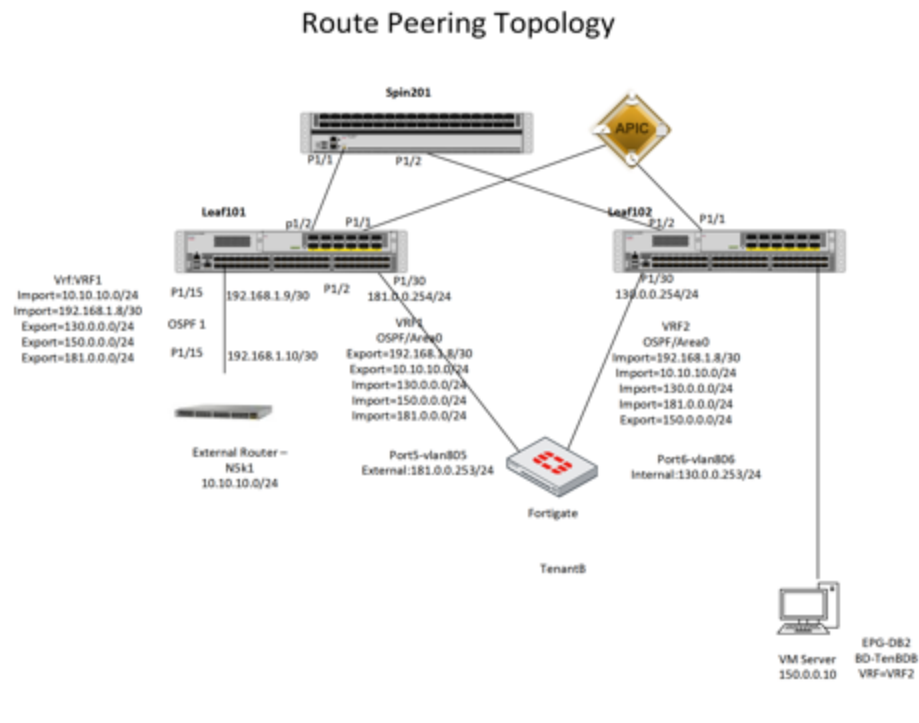
## Check the status and verify Device Selection Policy



Verify deployed Graph Instance



## Deploying Firewall Service for North-to-South traffic with OSPF



### Introduction:

This document describes the configuration walkthrough of L4-L7 Service Graph with Route Peering, where the consumer is external to ACI Fabric and the provider is internal to the Cisco ACI Fabric. With route peering feature provided by Cisco APIC, external traffic can reach internal servers through L4-L7 Services.

### Prerequisites:

Please pre-configure below configuration before deploying this design:

- Fabric Access Policies creation relating to Vlan Pools, Domain, Attachable Access Entity Profiles, Interface Policies and Switch Policies
- Layer3 Connection Outside of ACI Fabric
- L4-L7 Device Package has imported into Cisco APIC

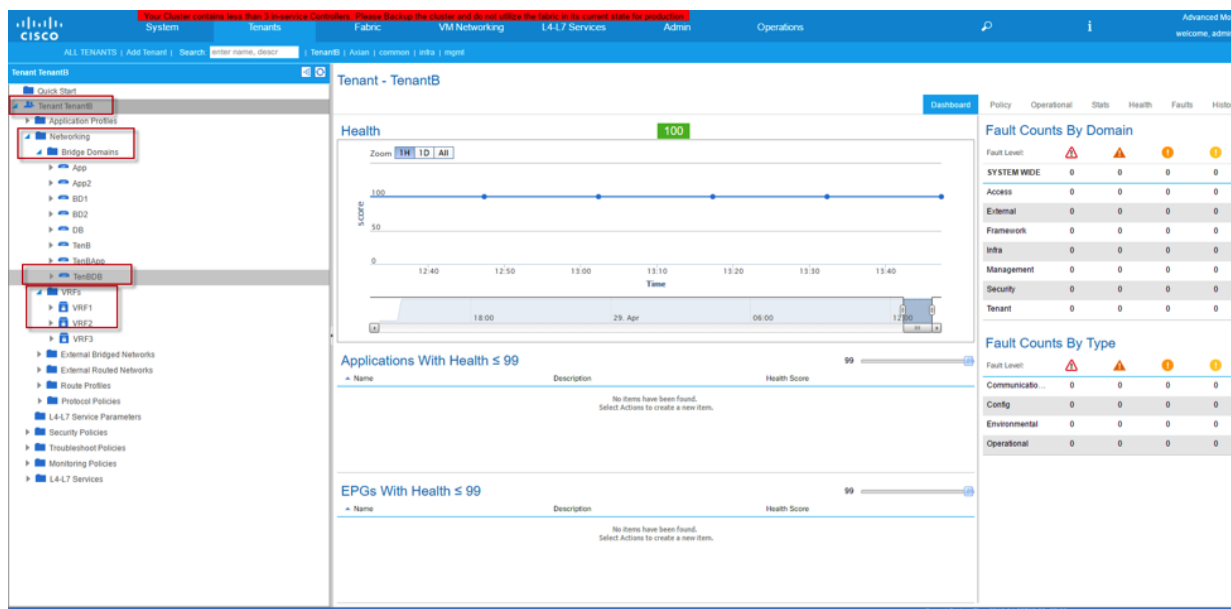
### Work Flow:

1. Configure routing configuration on external router that attached to ACI Fabric
2. Create Tenant (TenantB in our example)
3. Create VRFs (VRF1 and VRF2 in our example)
4. Create Bridge Domain and map to VRF2 ( TenBDB in our example)

5. Create EPG “EPG-DB2” and map it to Bridge Domain “TenBDB”
6. Create three L3Out EPGs (1 for external Connection, 1 for Firewall External and 1 for Firewall Internal. In our example, we used “N5k-1” for external Connection, “FortigateExternalOut” for Firewall External and “FortigateInternal” for Firewall Internal)
7. Create gateway IP on Bridge Domain (TenBDB) for VM Server
8. Ensure “Unicast Routing” is checked on Bridge Domain “TenBDB”
9. In Bridge Domain “TenBDB”, associate L3Outs to “FortigateInternal”
10. Map VM Server to EPG “EPG-DB2” and configure IP address and gateway ip address (TenBDB ip address)
11. Verify VM Server can ping to gateway IP
12. Create L4-L7 Device
13. Create Functional Profile Group as well as Functional Profile
14. Create Route Profiles
15. Create L4-L7 Service Graph Template
16. Deploy L4-L7 Service Graph

## Configuration:

### Configure the Bridge Domain TenBDB, VRF1 and VRF2. Associate Bridge Domain TenBDB to VRF2



## Configure L4-L7 Device for physical Fortigate (GoTo Mode)

**L4-L7 Devices - RPTransit**

**General**

Managed: ☒ **RPTransit**

Device Package: Fortinet-FGAPIC-1.2

Service Type: Firewall

Device Type: PHYSICAL

Physical Domain: FWDomain

Context Aware: Multiple

Function Type: GoThrough GoTo

Cluster Mode: Single Node

**Credentials**

Username: admin

Password:

Confirm Password:

**Configuration State**

Configuration Issues:

Devices State: stable

**Device 1**

Management IP Address: 10.160.11.13

Management Port: 443

Chassis: select a value

**Interfaces**

Name	Path
ports	Node-101eth1/30
ports	Node-102eth1/30

**Cluster**

Management IP Address: 10.160.11.13

Management Port: 443

Device Manager: select a value

**Cluster Interfaces**

Type	Name	Concrete Interfaces
consumer	Ext	RPTransit_Device_1(port5)
provider	Int	RPTransit_Device_1(port5)

## Configure L3Out for N5K-1 and associate to VRF1



All L3Out Interfaces which are used for Route Peering are required to be configured as a SVI with Vlan Encapsulation accordingly.

**L3 Outside - N5k-1**

**Properties**

Tags:

Label:

Target DSCP: unspecified

Route Control Enforcement: ☐ Import ☒ Export

Resolved VRF: TenantB/VRF1

External Routed Domain: Internet

Route Profiles for Interface: select a value

Route Control For Dampening:

Address Family Type:

Route Dampening Policy: No items have been found. Select Actions to create a new item.

Enable BGP/OSPF: ☐ BGP ☒ OSPF

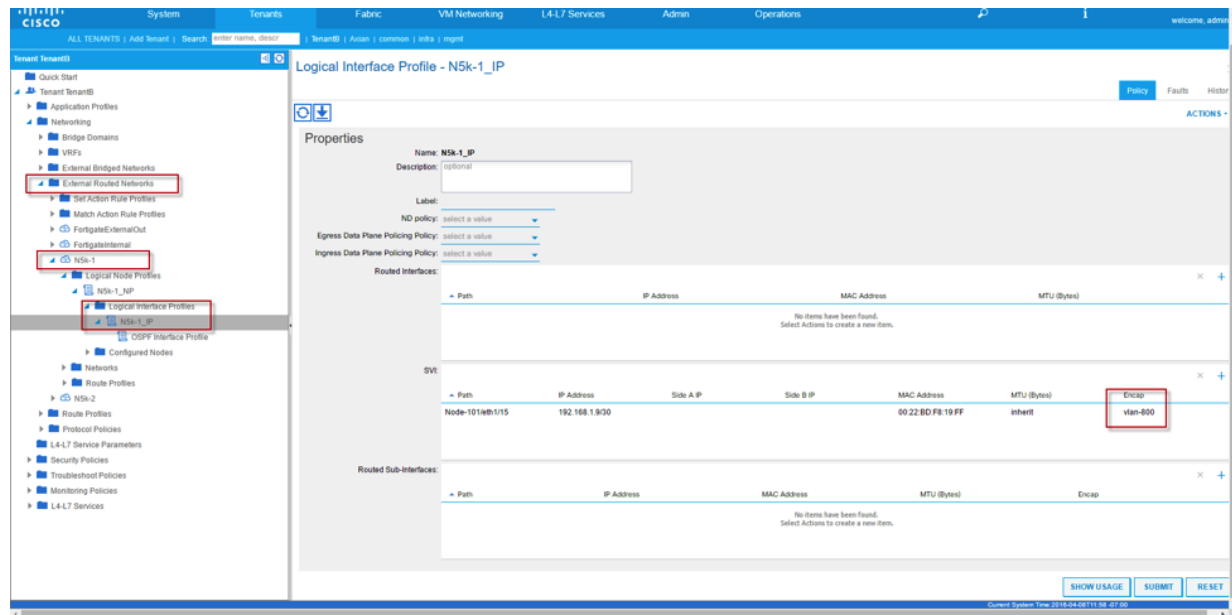
OSPF Area ID: 0.0.0.1

OSPF Area Control: ☒ Send redistributed LSAs into NSSA area ☒ Originate summary LSA ☐ Suppress forwarding address in translated LSA

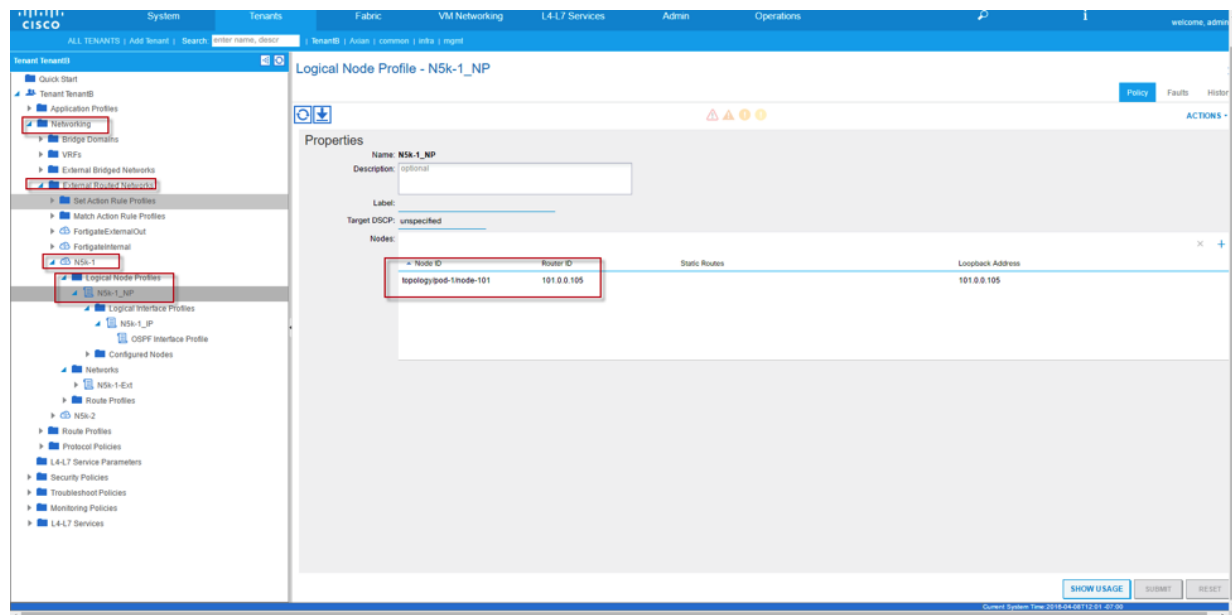
OSPF Area Type: NSSA area Regular area Stub area

OSPF Area Cost: 1

## Configure SVI for L3Out N5k-1



## Configure Route ID (101.0.0.105 in our example)



## Configure Import/Export Route Control on Subnets for N5k-1 L3Out External EPG

**External Network Instance Profile - N5k-1-Ext**

**Properties**

Name: N5k-1-Ext

Tags: [empty]

Description: [empty]

Configured VRF name: VRF1

Resolved VRF: units-TenantB1c1c1-VRF1

QoS Class: Unspecified

Target DSCP: unspecified

Configuration Status: **Applied**

**Configuration Issues:**

Subnets	Scope	Aggregate	Route Control Profile	Route Summarization Policy
10.10.10.0/24	External Subnets for the External EPG			
130.0.0.0/24	Export Route Control Subnet			
150.0.0.0/24	Export Route Control Subnet			
181.0.0.0/24	Export Route Control Subnet			
192.168.1.0/30	External Subnets for the External EPG			

Route Control Profile: [empty]

No items have been found. Select Actions to create a new item.

## Configure L3Out for Fortigate External Interface (FortigateExternalOut) and associate with VRF1



In our example, the route ID here must be the same as above (101.0.0.105), since both L3outs are on the same leaf switch.

**L3 Outside - FortigateExternalOut**

**Properties**

Tags: [empty]

Label: [empty]

Target DSCP: unspecified

Route Control Enforcement: ☐ Import ☒ Export

VRF: TenantB/VRF1

Resolved VRF: TenantB/VRF1

External Routed Domain: Internet

Route Profile for Interleaf: select a value

**Route Control For Dampening:**

Address Family Type: [empty]

Route Dampening Policy: [empty]

Enable BGP/EGRP/OSPF: ☐ BGP ☐ EIGRP ☒ OSPF

OSPF Area ID: 0

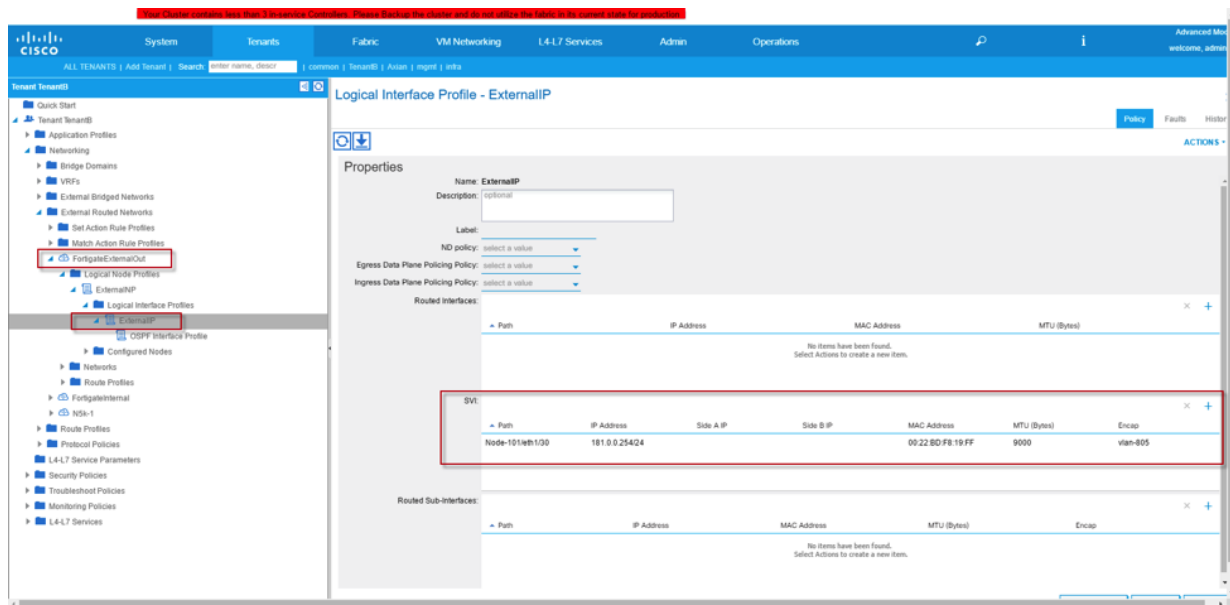
OSPF Area Control: ☒ Band redistributed LSAs into NSSA area ☒ Originate summary LSA ☐ Suppress forwarding address in translated LSA

OSPF Area Type: NSSA area Regular area Stub area

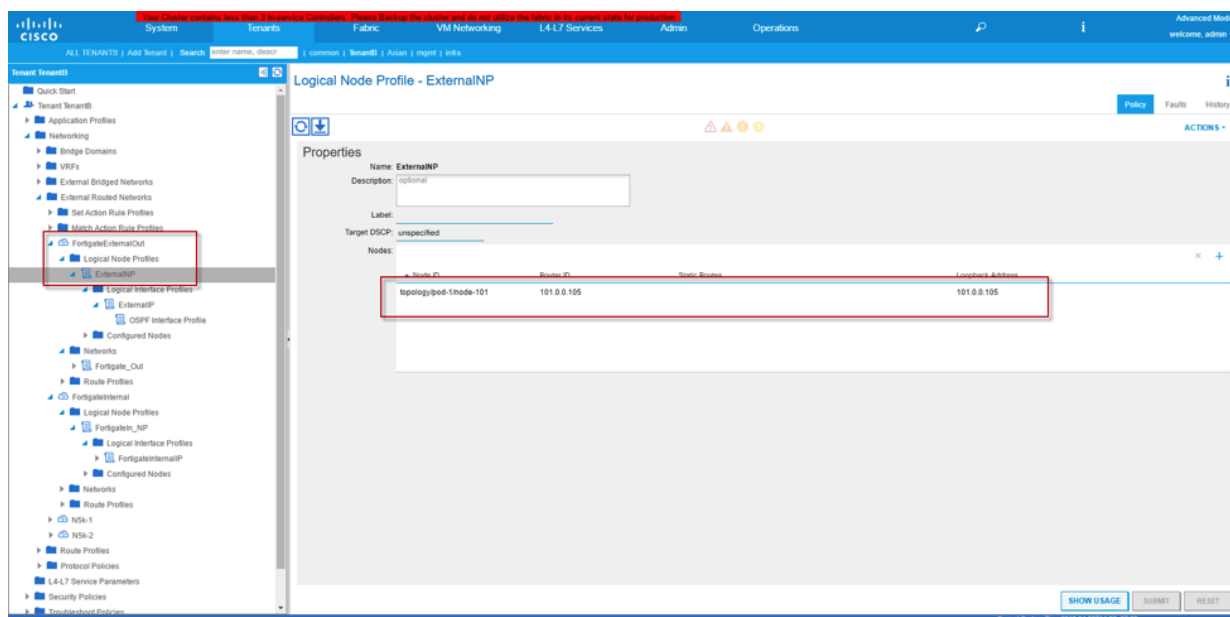
OSPF Area Cost: 1

SHOW USAGE SUBMIT RESET

## Configure SVI for L3Out Fortigate External out (FortigateExternalOut)



## Configure Route ID for L3Out Fortigate External Out (FortigateExternalOut)





## Configure Import/Export Route Control on Subnets for Fortigate External out

The screenshot displays the Fortinet FortiGate GUI for configuring the 'FortigateExternalOut' profile. The left sidebar shows the navigation tree with 'FortigateExternalOut' highlighted under 'Network' > 'External Routed Networks'. The main panel is titled 'External Network Instance Profile - Fortigate\_Out' and shows the 'Properties' tab. The 'Configured VRF name' is 'VRF1'. The 'Resolved VRF' is 'units-TenantB1ctx-VRF1'. The 'QoS Class' is 'Unspecified'. The 'Target DSCP' is 'unspecified'. The 'Configuration Status' is 'Applied'. The 'Subnets' table lists the following subnets:

Subnets	Scope	Aggregate	Route Control Profile	Route Summarization Policy
10.10.10.0/24	Export Route Control Subnet			
130.0.0.0/24	External Subnets for the External EPG			
150.0.0.0/24	External Subnets for the External EPG			
181.0.0.0/24	External Subnets for the External EPG			
192.168.1.0/24	Export Route Control Subnet			

## Configure L3Out for Fortigate Internal (FortigateInternal) and associate with VRF2

The screenshot displays the Fortinet FortiGate GUI for configuring the 'FortigateInternal' profile. The left sidebar shows the navigation tree with 'FortigateInternal' highlighted under 'Network' > 'External Routed Networks'. The main panel is titled 'L3 Outside - FortigateInternal' and shows the 'Properties' tab. The 'Route Control Enforcement' is set to 'Import'. The 'VRF' is 'TenantB/VRF 2'. The 'Resolved VRF' is 'TenantB/VRF2'. The 'External Routed Domain' is 'Internet'. The 'Route Profile for Interleak' is 'select a value'. The 'Route Control For Dampening' is set to 'Address Family Type'. The 'Enable BGP/EGRP/OSPF' section shows 'OSPF' checked. The 'OSPF Area ID' is '0'. The 'OSPF Area Control' section shows 'Send redistributed LSAs into NSSA area' checked, 'Originate summary LSA' checked, and 'Suppress forwarding address in translated LSA' checked. The 'OSPF Area Type' is 'NSSA area'. The 'OSPF Area Cost' is '1'.

## Configure SVI for L3Out Fortigate Internal (FortigateInternal)

**Logical Interface Profile - FortigateInternalIP**

**Properties**

Name: FortigateInternalIP  
Description: optional  
Label:   
ND policy: select a value  
Egress Data Plane Policing Policy: select a value  
Ingress Data Plane Policing Policy: select a value

**Routed Interfaces**

Path	IP Address	MAC Address	MTU (Bytes)
No items have been found. Select Actions to create a new item.			

**SVI**

Path	IP Address	Side A IP	Side B IP	MAC Address	MTU (Bytes)	Encap
Node-102wh100	130.0.0.254/24			00:22:8D:F8:19:FF	9000	vlan-806

**Routed Sub-Interfaces**

Path	IP Address	MAC Address	MTU (Bytes)	Encap
No items have been found. Select Actions to create a new item.				

## Configure Route ID for L3Out Fortigate Internal (FortigateInternal)

**Logical Node Profile - FortigateInternal\_NP**

**Properties**

Name: FortigateInternal\_NP  
Description: optional  
Label:   
Target DSCP: unspecified

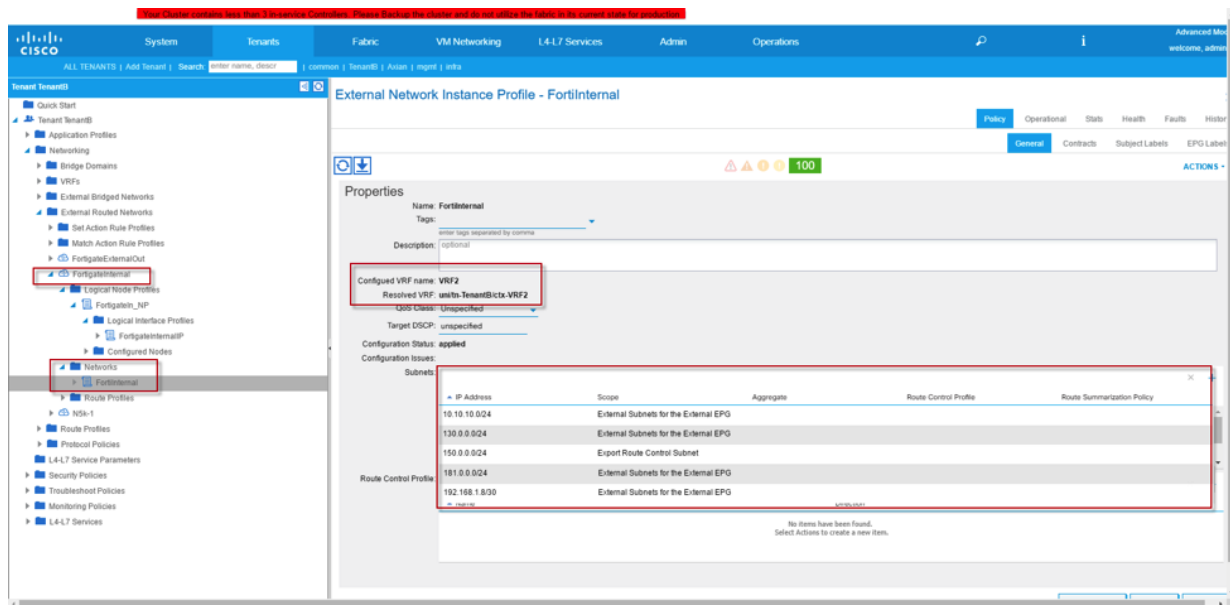
**Nodes**

Node ID	Router ID	Static Routes	Loopback Address
topology/pod-1node-102	102.0.0.105		102.0.0.105

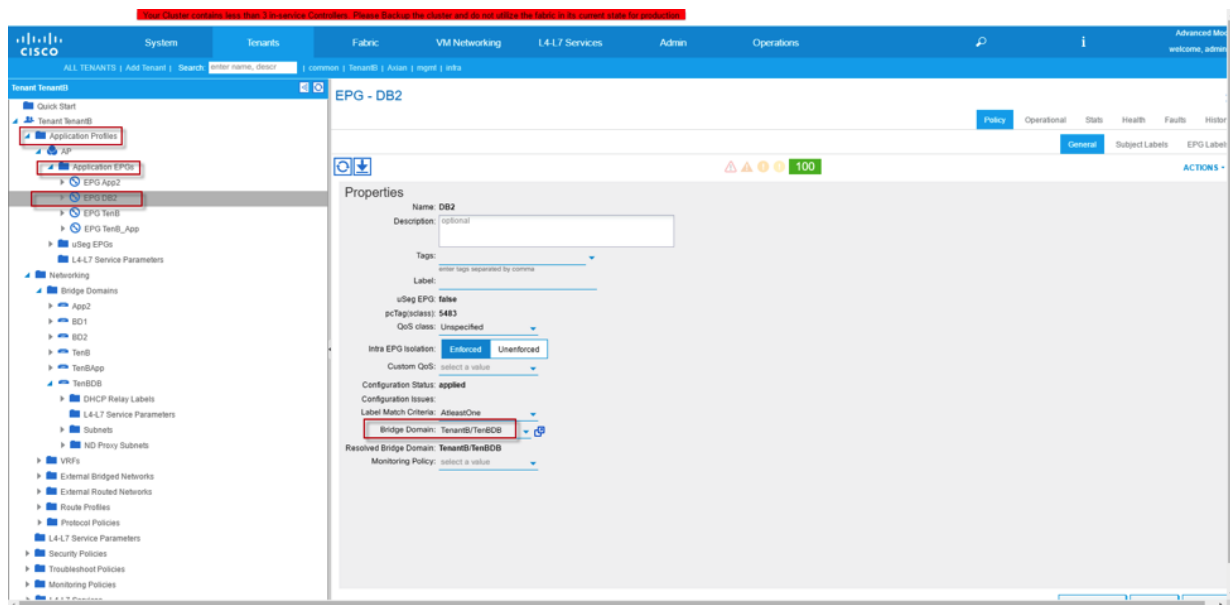
SHOW USAGE SUBMIT RESET

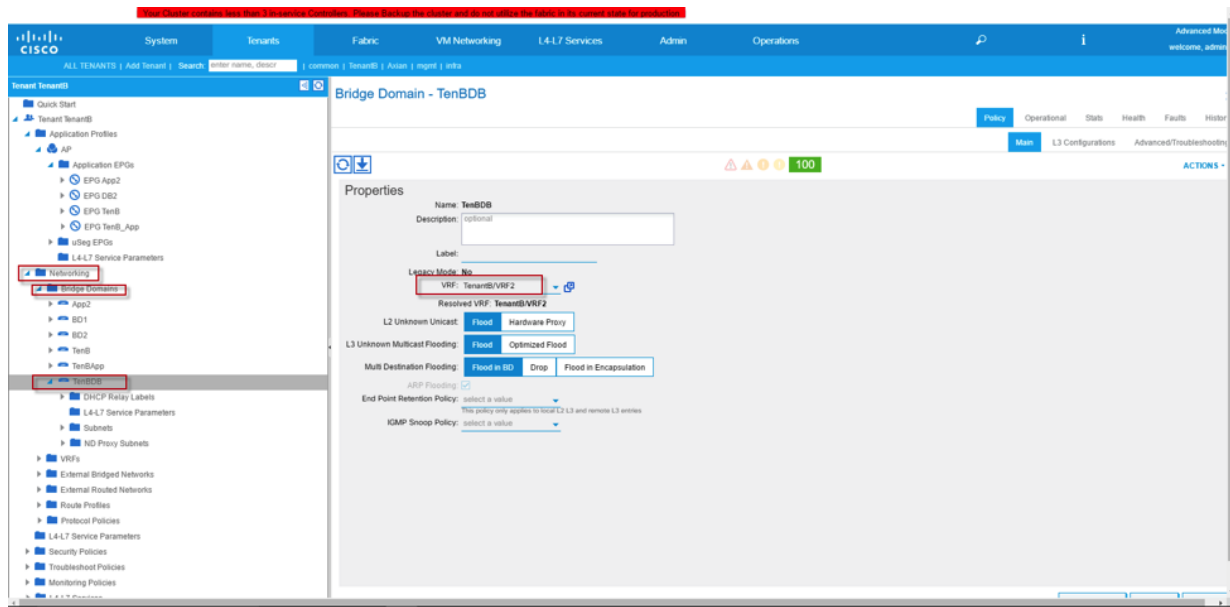
Current System Time: 2018-04-09T14:22:07:00

## Configure Import/Export Route Control on Subnet for L3Out Fortigate Internal (FortigateInternal)

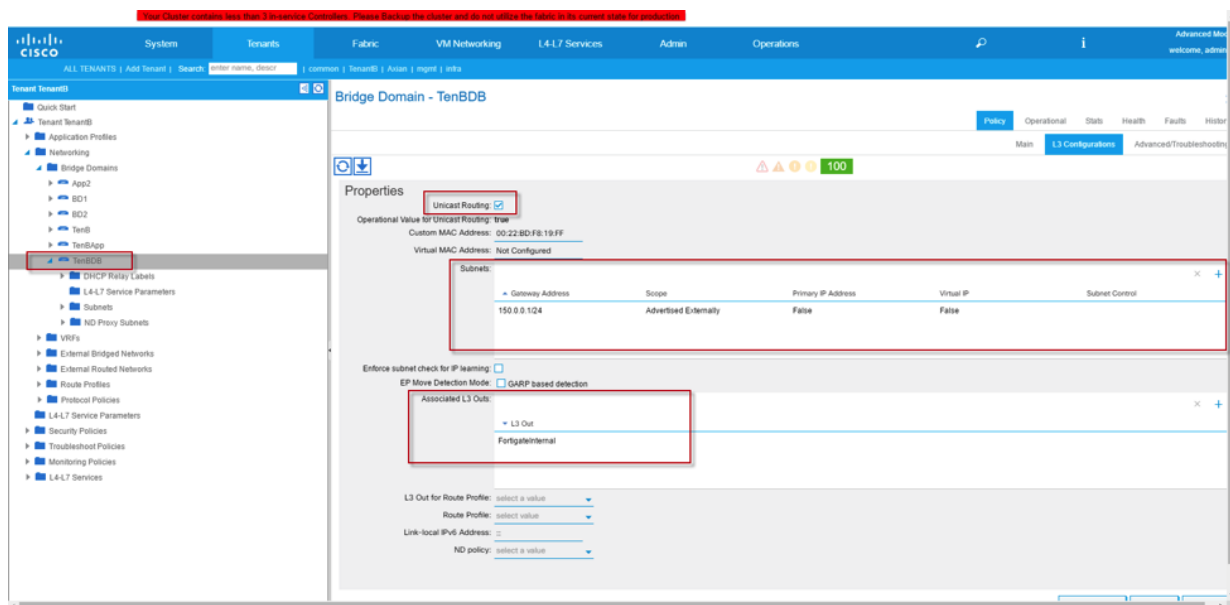


## Associate EPG “DB2” to Bridge Domain “TenBDB” and attach Bridge Domain to VRF2

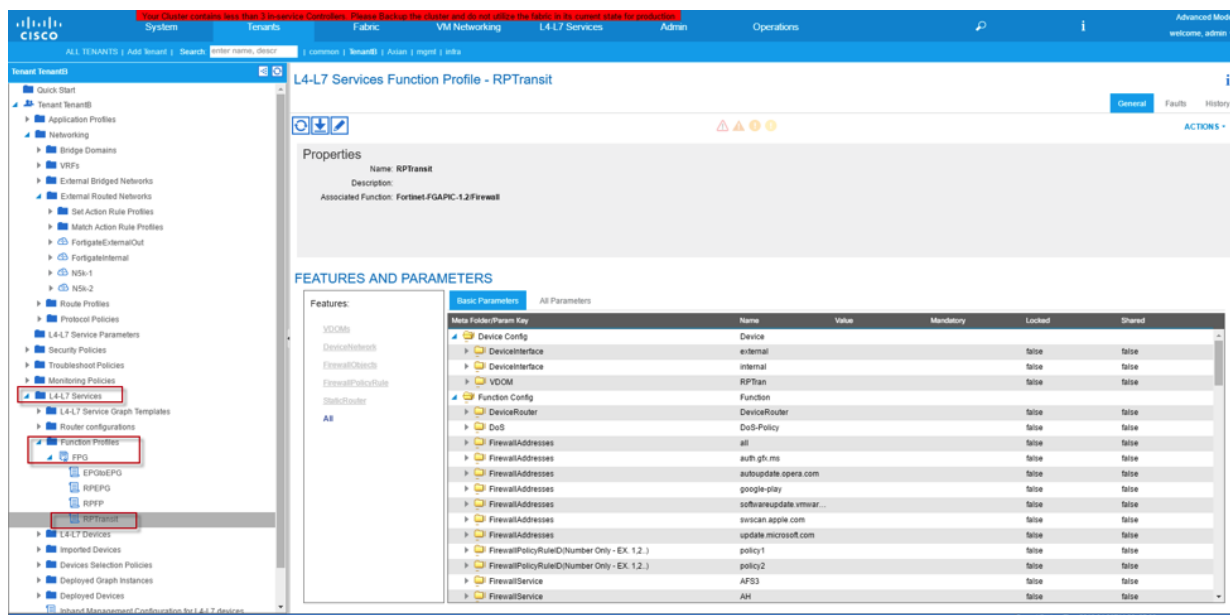
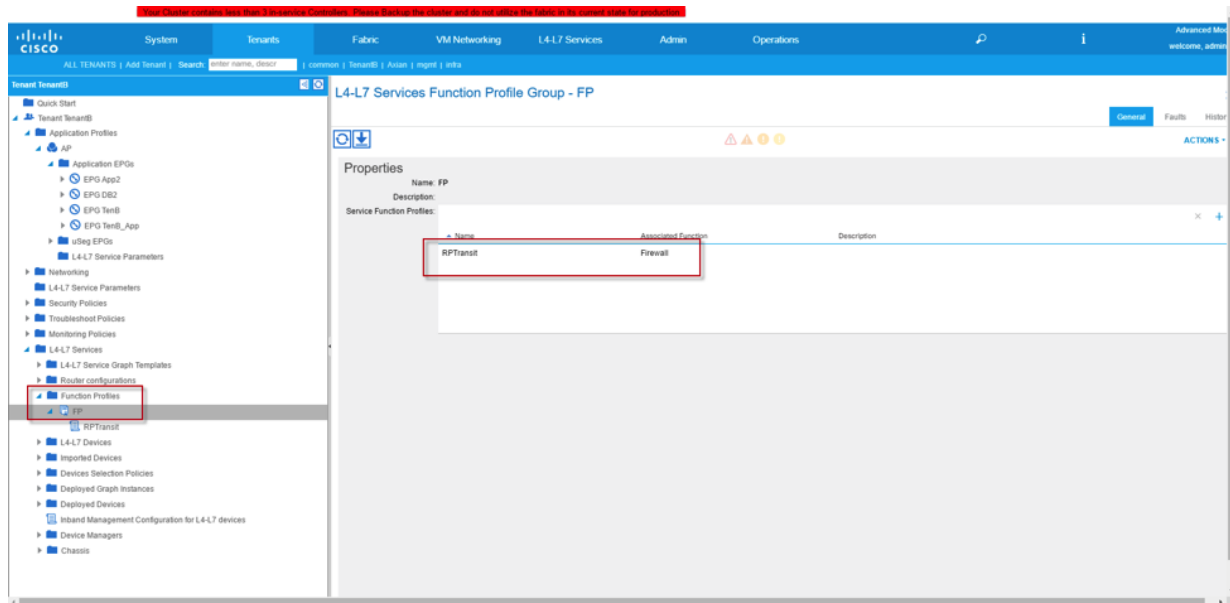




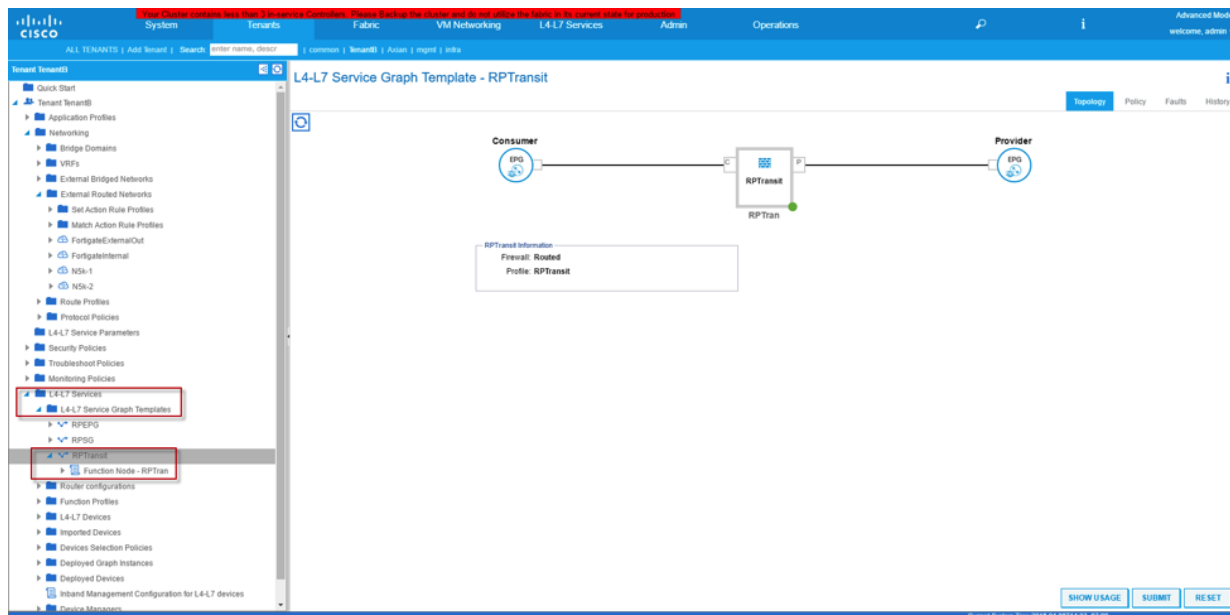
## Configure Bridge Domain with Unicast Routing, assign SVI and associate L3Outs to “FortigateInternal”



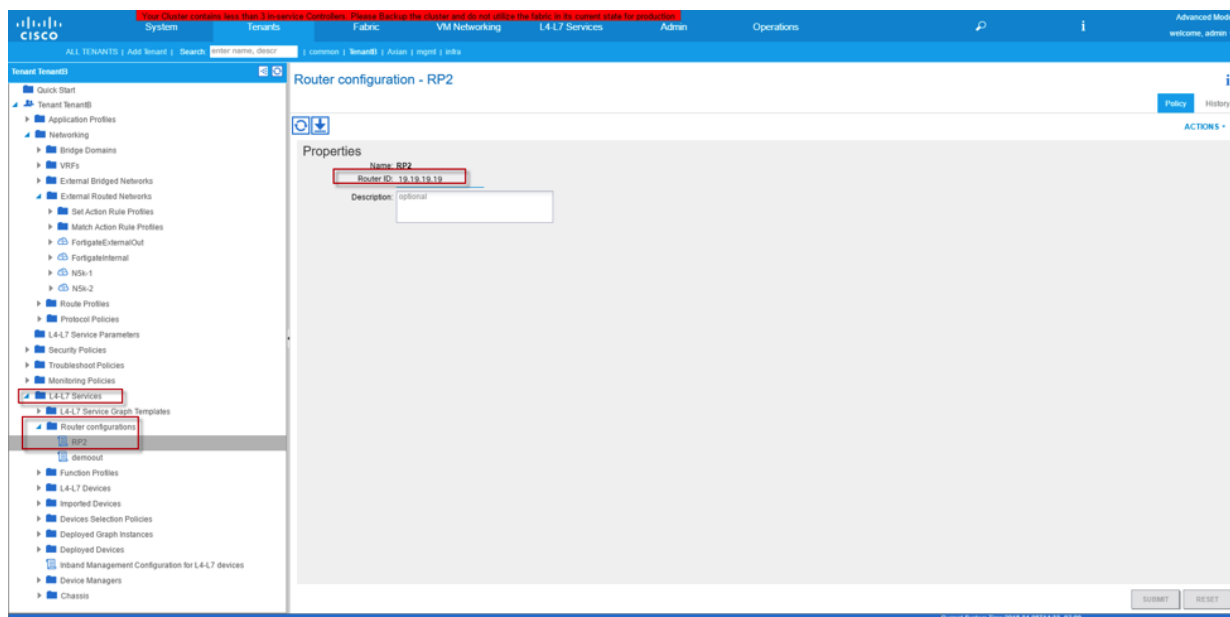
## Create Functional Profile Group and Functional Profile from existing template



## Create Service Graph template



## Create Router ID that will be used on the Service Appliance (Fortigate)



## Deploy Service Graph

**L4-L7 Service Graph Template - RPTransit**

**Properties**

Name: RPTransit  
 Template Name: UNSPECIFIED  
 Configuration Issues: optional  
 Description: optional

**Function Nodes:**

Name	Function Name	Function Type	Description
RPTran	FortinetFGAPIC-12Firewall	GoTo	

**Terminal Nodes:**

Name	Provider/Consumer	Description
T1	Consumer	
T2	Provider	

**Connects:**

Name	Connected Nodes	Unicast Route	Adjacency Type	Description
C1	RPTran, T1	True	L3	
C2	RPTran, T2	True	L3	

Buttons: SHOW USAGE, SUBMIT, RESET



Consumer will be L3Outs facing external router. Provider is the internal EPG. In our case will be N5k-1 and DB2 respectively.

**Apply L4-L7 Service Graph Template To EPGs**

**STEP 1 > Contract**

1. Contract 2. Graph

Config A Contract Between EPGs

Consumer EPG / External Network: TenantB/N5k-1/Ext  
 Provider EPG / External Network: TenantB/AP/epg-DB2

Contract Information  
 Contract: Create A New Contract  
 Contract Name: contract  
 No Filter (Allow All Traffic) ☒

Buttons: PREVIOUS, NEXT, CANCEL



Route peering needs to be select for Internal and external connections. In our example, we used "FortigateExternalOut" and FortigateInternal" as External and Internal selections respectively.

Apply L4-L7 Service Graph Template To EPGs

STEP 2 > Graph

1. Contract 2. Graph 3. RPTransit Parameters

Config A Service Graph

Device Clusters

- TenantB /EPGtoEPG (Managed Firewall)
- TenantB /FGRtoEPG (Managed Firewall)
- TenantB /RPtoEPG (Managed Firewall)
- TenantB /RPTransit (Managed Firewall)**

Graph Template: TenantB/RPTransit

Consumer: Fortigate\_Out

Provider: Fortigate\_In

RPTransit Information

Firewall: routed

Profile: RPTransit

Router Config: TenantB/RP2

Consumer Connector

Type: General **Route Peering**

L3 Ext Network: TenantB/FortigateExternalOut/Fortigate\_Out

Cluster Interface: Ext

Provider Connector

Type: General **Route Peering**

L3 Ext Network: TenantB/FortigateInternal/Fortigate\_In

Cluster Interface: Int

PREVIOUS NEXT CANCEL

Last minute check to make sure configuration is good before hit “Finish” button

Apply L4-L7 Service Graph Template To EPGs

STEP 3 > RPTransit Parameters

1. Contract 2. Graph 3. RPTransit Parameters

config parameters for the selected device

Profile Name: RPTransit

Required Parameters: All Parameters

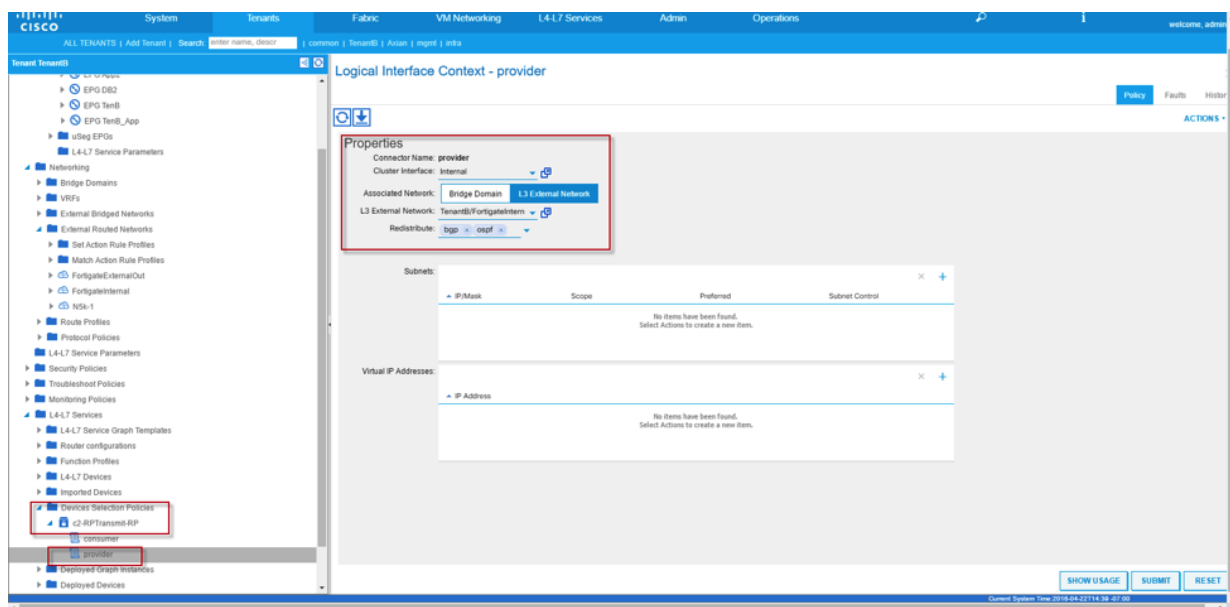
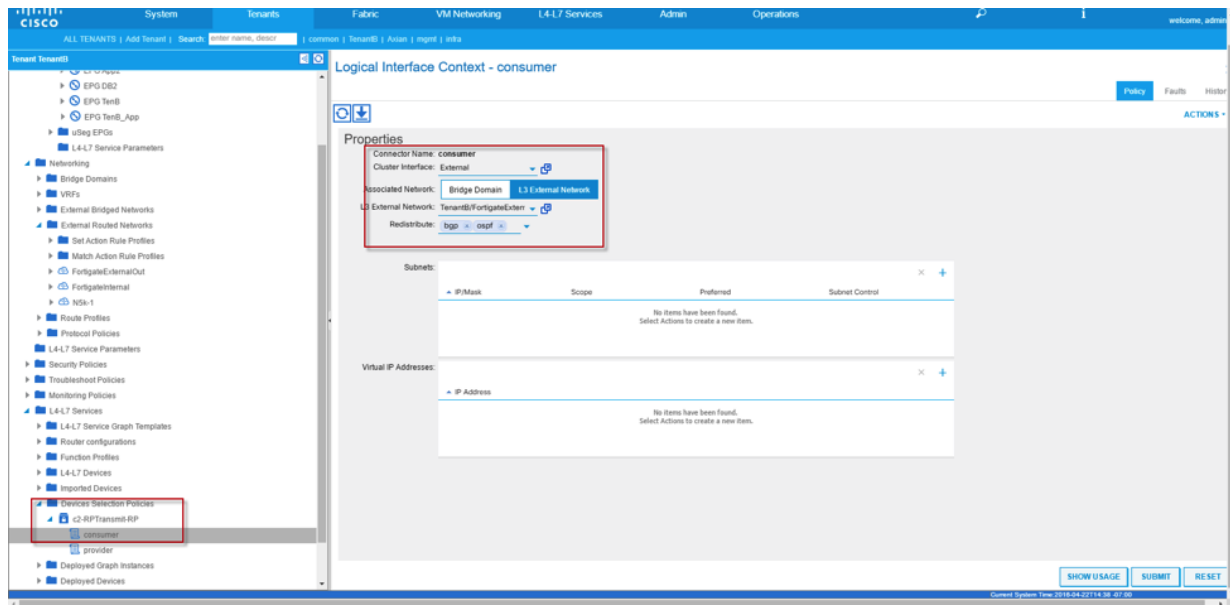
Feature	Parameter	Name	Value	Write Domain
Device Config	DeviceInterface	external		
	DeviceInterface	internal		
VDOM	VDOM	RPTran		
Function Config	Function	Function		
DeviceRouter	DeviceRouter	DeviceRouter		
DoS	DoS	DoS-Policy		
FirewallAddresses	FirewallAddresses	all		
	FirewallAddresses	auth.gn.ms		
	FirewallAddresses	autoupdate.opera.com		
	FirewallAddresses	google-play		
	FirewallAddresses	softwareupdate.vmware.com		
	FirewallAddresses	update.microsoft.com		

RED indicators parameters needed to be updated and GREEN indicates parameters will be submitted to the provider EPG.

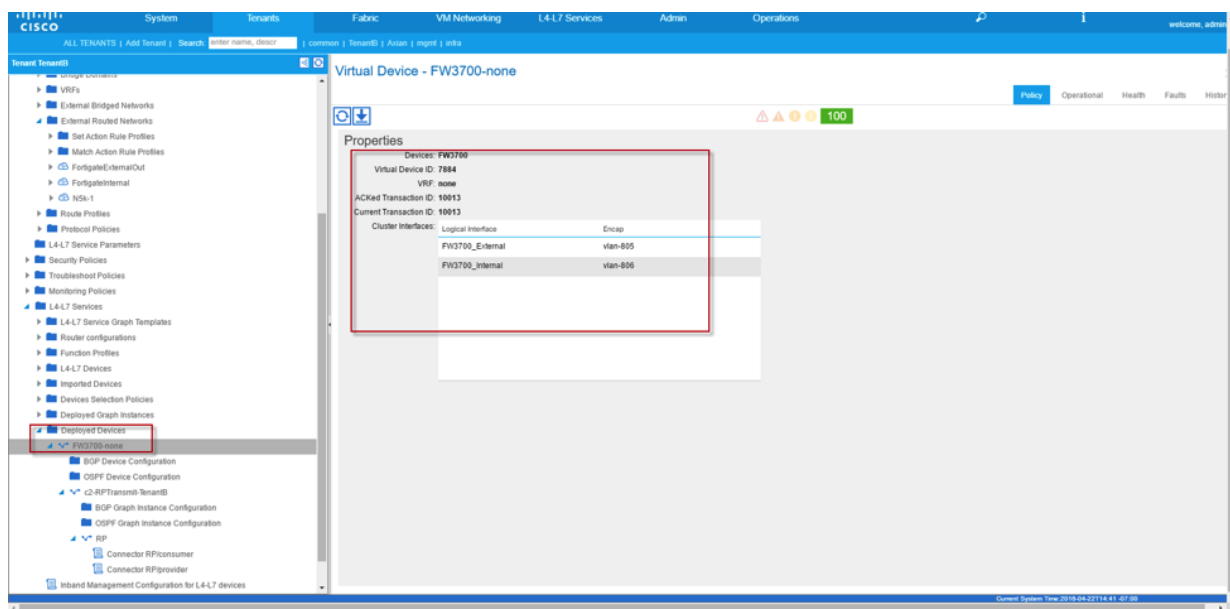
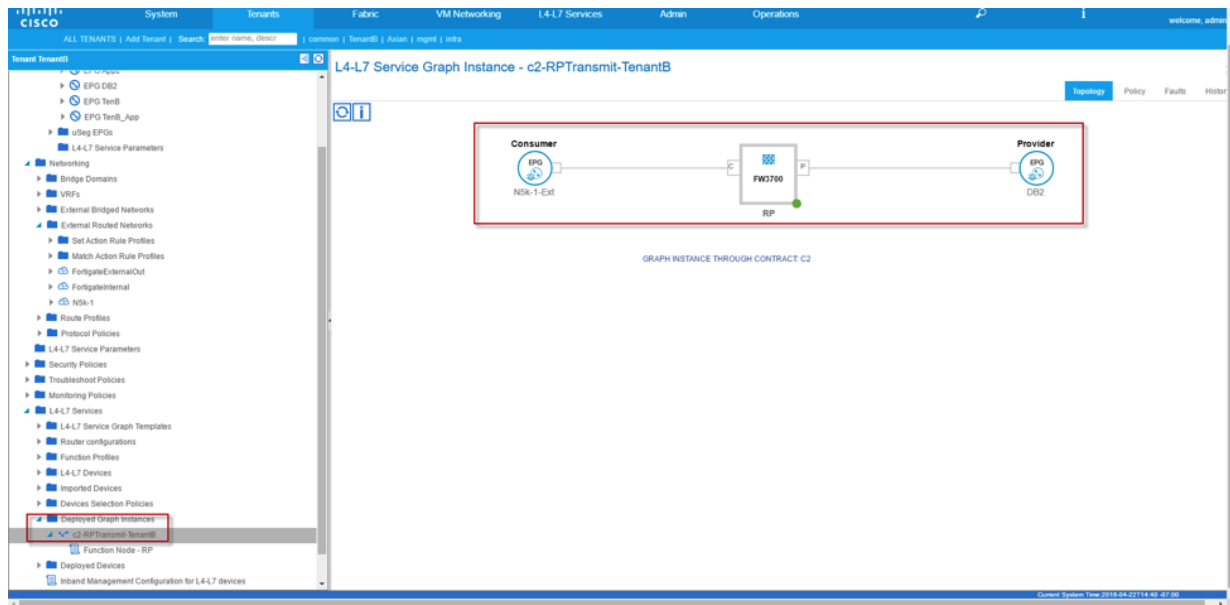
PREVIOUS **FINISH** CANCEL



## Check the status and verify Device Selection Policy



## Verify deployed Graph Instance



## Deploying Firewall service with Fortigate-VM and VmWare

### Pre-requisite

- Fabric Access Policies creation relating to Vlan Pools, Domain, Attachable Access Entity Profiles, Interface Policies and Switch policies
- Create Tenant, VRF, 2 Bridge Domains, 2 EPGs
- Associate 2 Bridge Domains to VRF
- Associate 2 EPGs to the 2 Bridge Domains
- Layer4-7 Device Package has imported into Cisco APIC

### Work Flow:

1. Create Go-Through mode Fortigate VM Devices on Cisco APIC
2. Create Functional Profile
3. Create Service Graph Template
4. Deploy Service Graph

### Configuration

#### Create Layer 4-L7 Device on Cisco APIC

The screenshot displays the Cisco APIC GUI for configuring L4-L7 Devices. The left sidebar shows the navigation tree with 'L4-L7 Devices' selected. The main panel is titled 'L4-L7 Devices - FGVM2' and contains the following sections:

- General:**
  - Managed: ☒
  - Name: FGVM2
  - Device Package: Fortinet-FGAPIC-1.2
  - Service Type: Firewall
  - Device Type: VIRTUAL
  - VMM Domain: vcenter
  - Content Aware: Single
  - Function Type: Go Through (selected), Go To
  - Cluster Mode: Single Node
- Credentials:**
  - Username: admin
  - Password: (masked)
  - Confirm Password: (masked)
- Configuration State:**
  - Configuration Issues: (empty)
  - Devices State: stable
- Device 1:**
  - Management IP Address: 10.160.11.103
  - Management Port: 443
  - vCenter Name: vcenter
  - VM Name: FGVM103
  - Chassis: (select a value)
  - Interfaces:
 

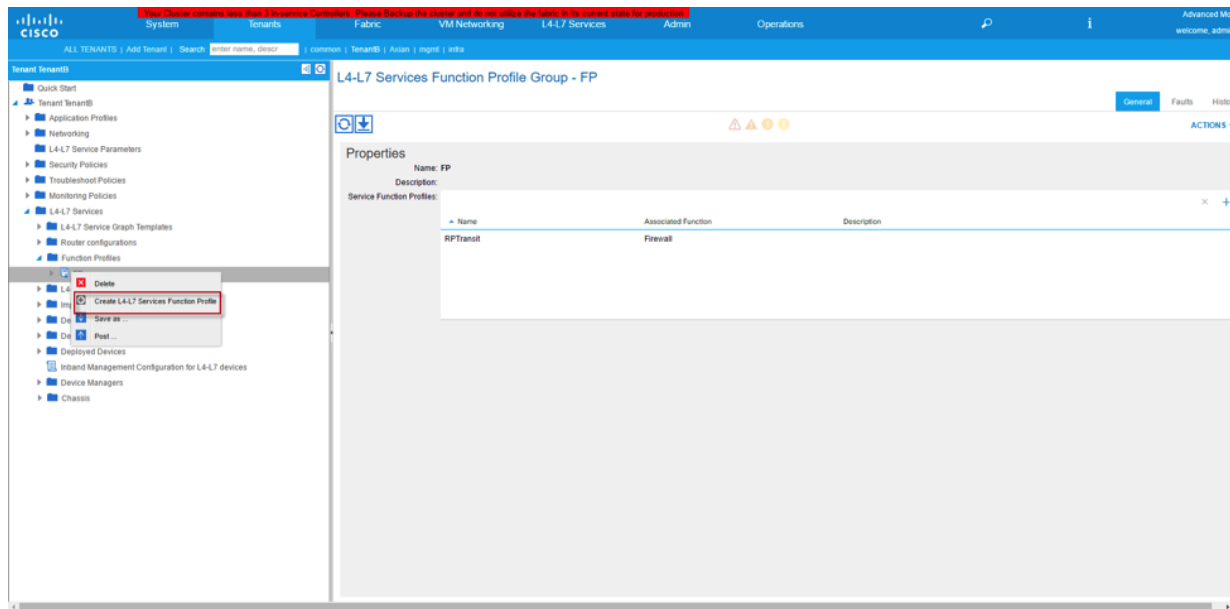
Name	VNIC	Path (Only For Route Peering)
port2	Network adapter 2	Node-1011nb102
port3	Network adapter 3	Node-1011fe-1011nb102
- Cluster:**
  - Management IP Address: 10.160.11.103
  - Management Port: 443
  - Device Manager: (select a value)
  - Cluster Interfaces:
 

Type	Name	Concrete Interfaces
provider	ins	FGVM2_Device_1[port3]
consumer	out	FGVM2_Device_1[port2]

At the bottom right, there are buttons for 'SHOW USAGE', 'SUBMIT', and 'RESET'.

#### Create Functional Profile

Functional Profile defines the template for the Service(s) that is going to deploy such as L4-L7 Device Interface IP addresses, Rule ID, Object Addresses, Policy Rules, Source/Destination Ports...etc.



## Functional Profile Objects Explanation under “Features”

### Device Network:

Contained External and Internal Interfaces that will be programmed onto Fortigate VDOM. This is the interfaces (typically external and internal) that will be associated to the VDOM.



Similar to above notes, for Go-To Mode, please modify the IP address field otherwise leave the default for Go-Through Mode.

### Firewall Objects:

This field allows user to customize Firewall Addresses, Service and scheduling.

### Firewall Policy Rule:

This field encompassed the creation of Firewall policy that will be program onto Fortigate. Security Profile and Logging Options are also configured here.

### Static Router:

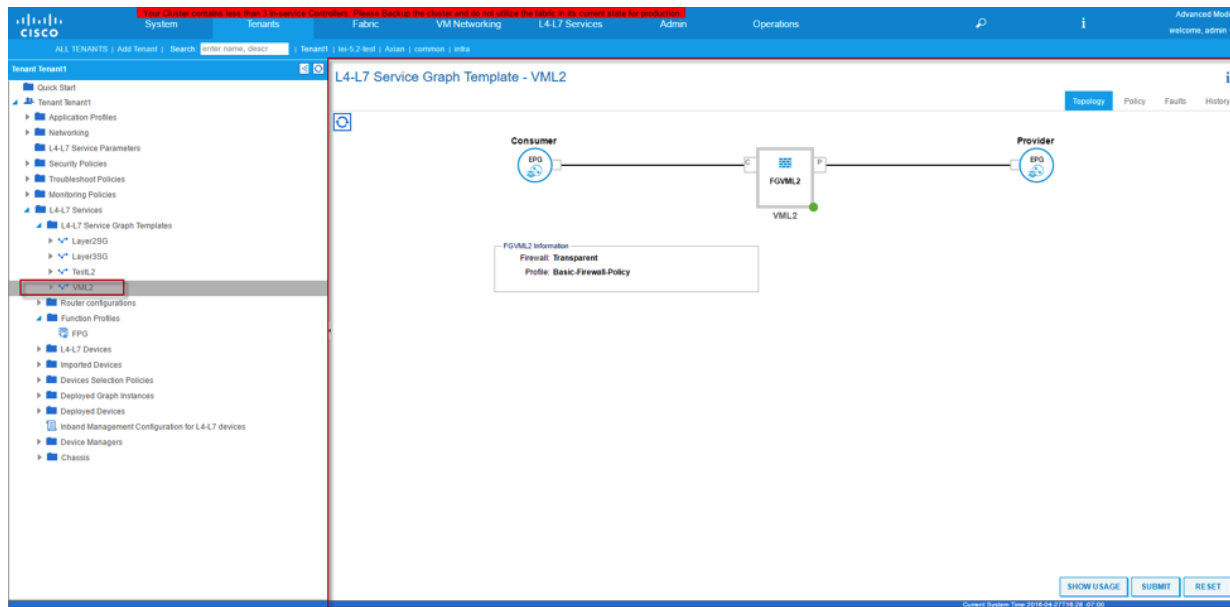
Allow user to configure static route that will be used on Fortigate.

### All:

This field listed all the parameters stated above plus DDOS configuration.

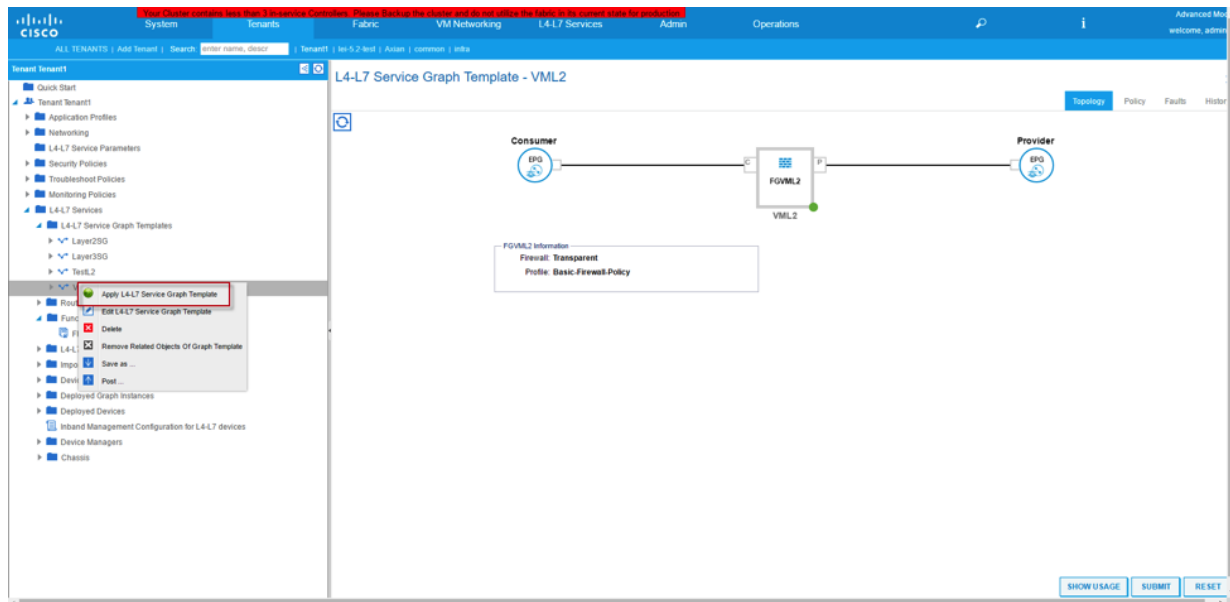
## Create Service Graph

Service Graph template is used to tightly coupled the Functional Profile or Firewall configuration and combine with the Firewall device we defined at earlier steps.

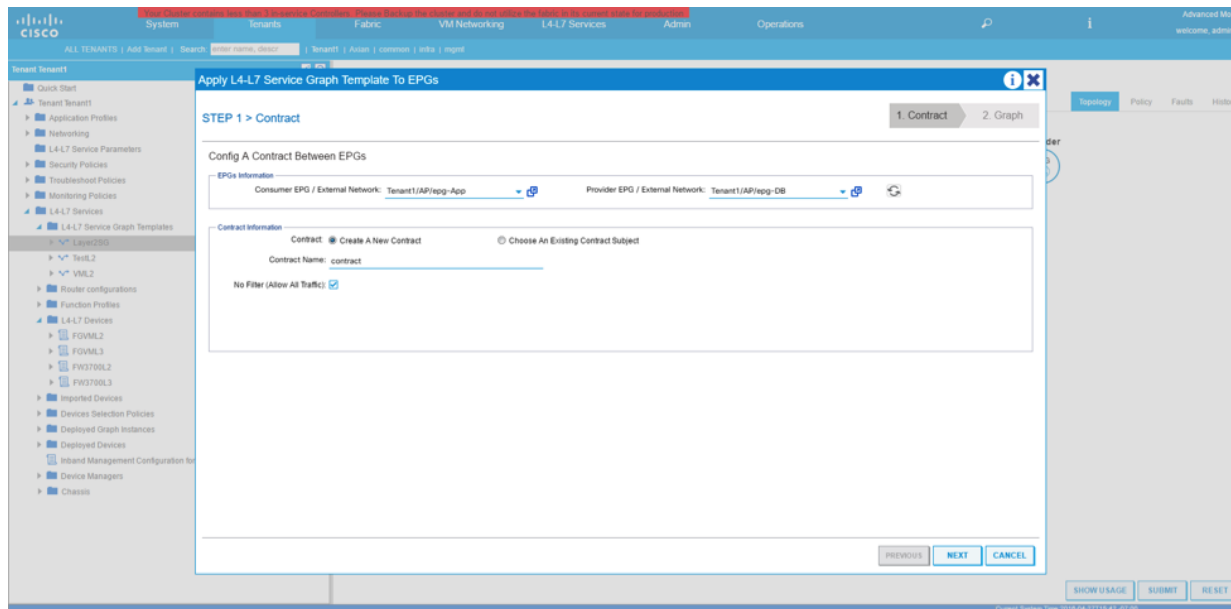


## Deploy Service Graph

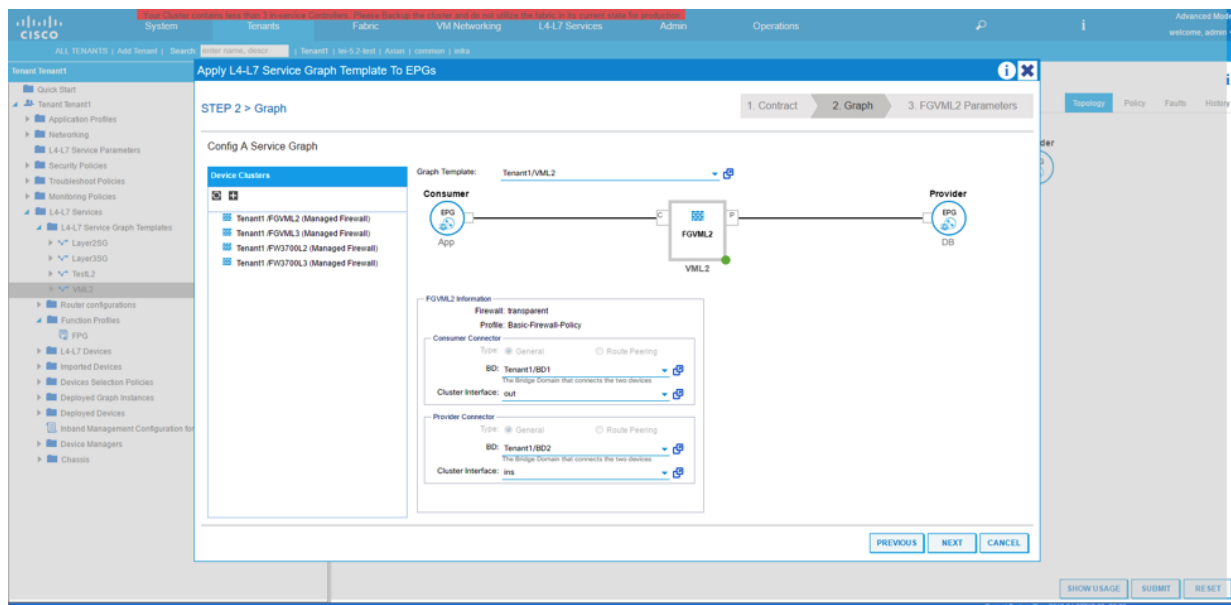
Once we combined the Firewall configuration and associated device together, we are ready to deploy the service Graph to create a VDOM.



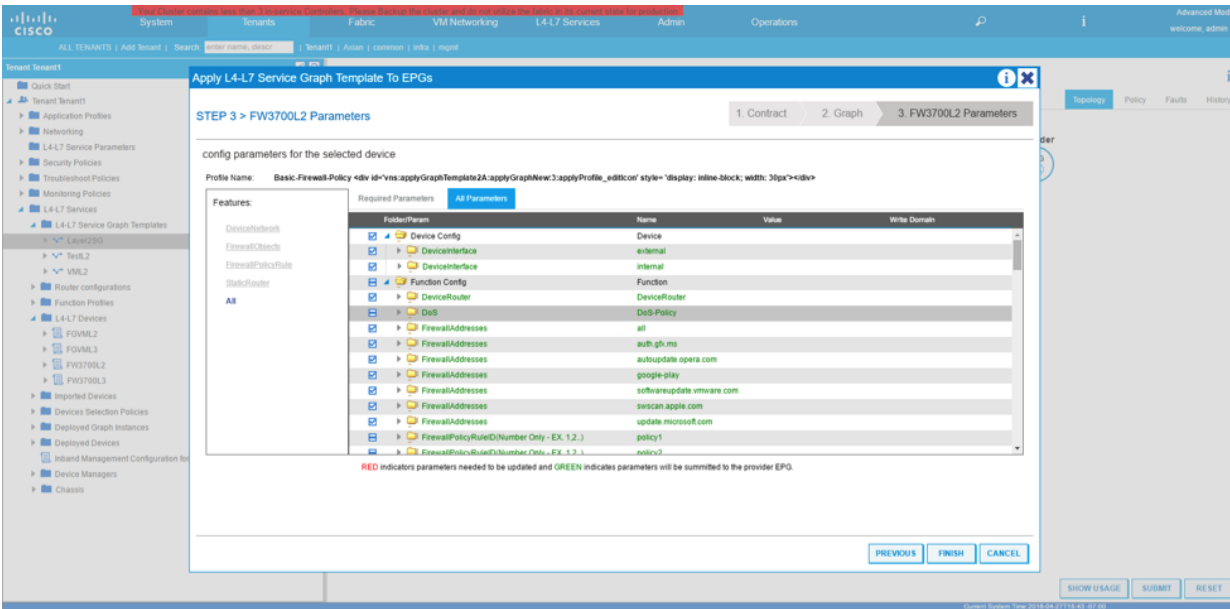
On next screen select the Consumer and provider EPGs and assign a contract name or select a pre-define contract.



Next screen select the logical interfaces defined during the creation of Layer4-7 Device.



Next screen to the last minute check to ensure everything is accordingly before deploy. If ok, then hit the submit button.



## Deploy the firewall device shared by multiple service graphs

### Pre-requisite

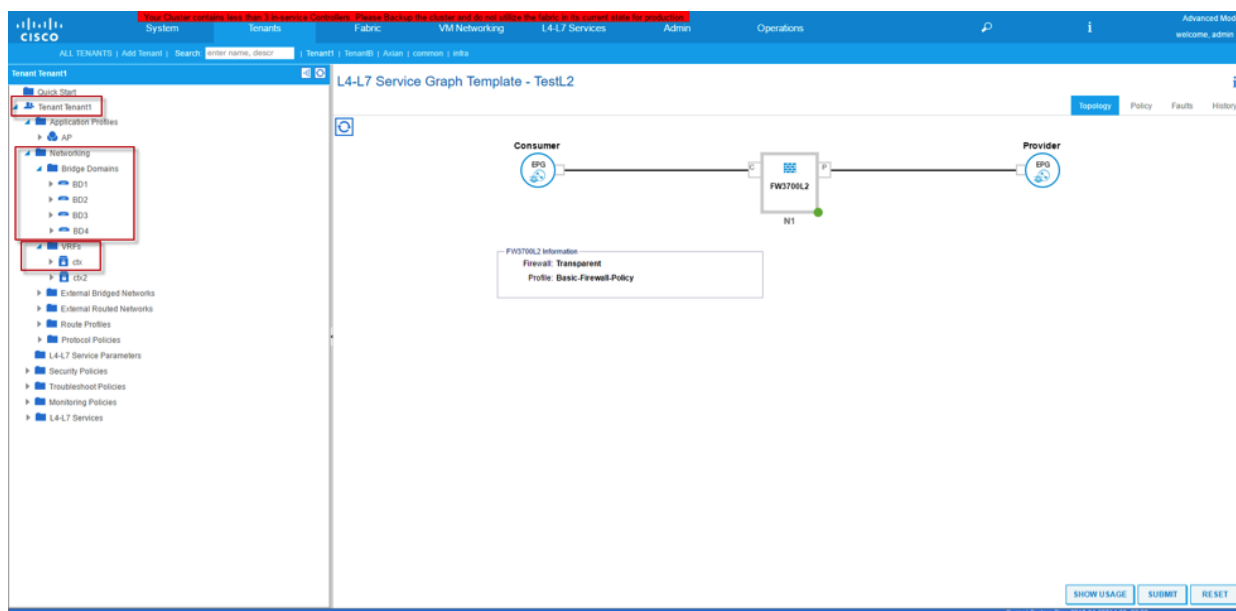
- Fabric Access Policies creation relating to Vlan Pools, Domain, Attachable Access Entity Profiles, Interface Policies and Switch policies
- Layer4-7 Device Package has imported into Cisco APIC

### Work Flow:

1. Create Tenant ( "Tenant1" in our example)
2. Create VRF ( "ctx" in our example)
3. Create 4 Bridge Domains ( "BD1", "BD2", "BD3" and "BD4" in our example)
4. Associate Bridge Domains to VRF
5. Create 4 EPGs ( "App", "App2", "DB", "DB2" in our example)
6. Associate EPGs to Bridge Domains (EPG "App", "App2", "DB" and "DB2" are mapped to Bridge Domain "BD1", "BD2", "BD3" and "BD4" respectively in our example)
7. Create Go-Through mode Device on Cisco APIC and define 4 logical interfaces
8. Create Functional Profile
9. Create 2 Service Graph Templates
10. Deploy Service Graph 2 times on the same device but with different EPG pairs

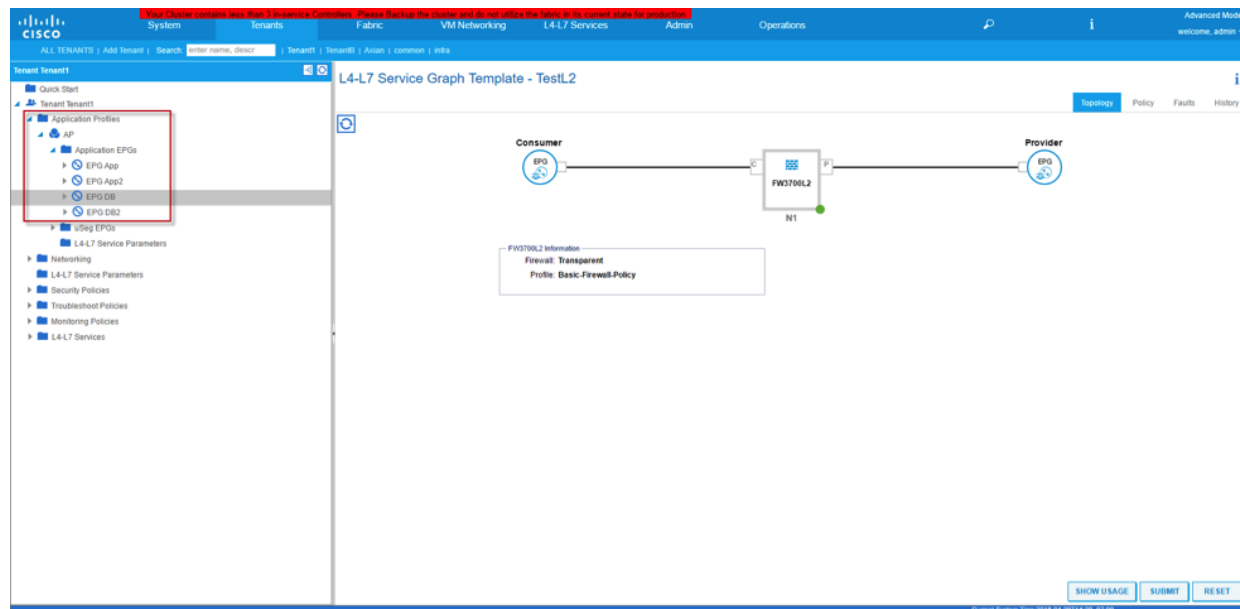
### Configuration

#### Create Tenant, VRF and 4 Bridge Domains on Cisco APIC

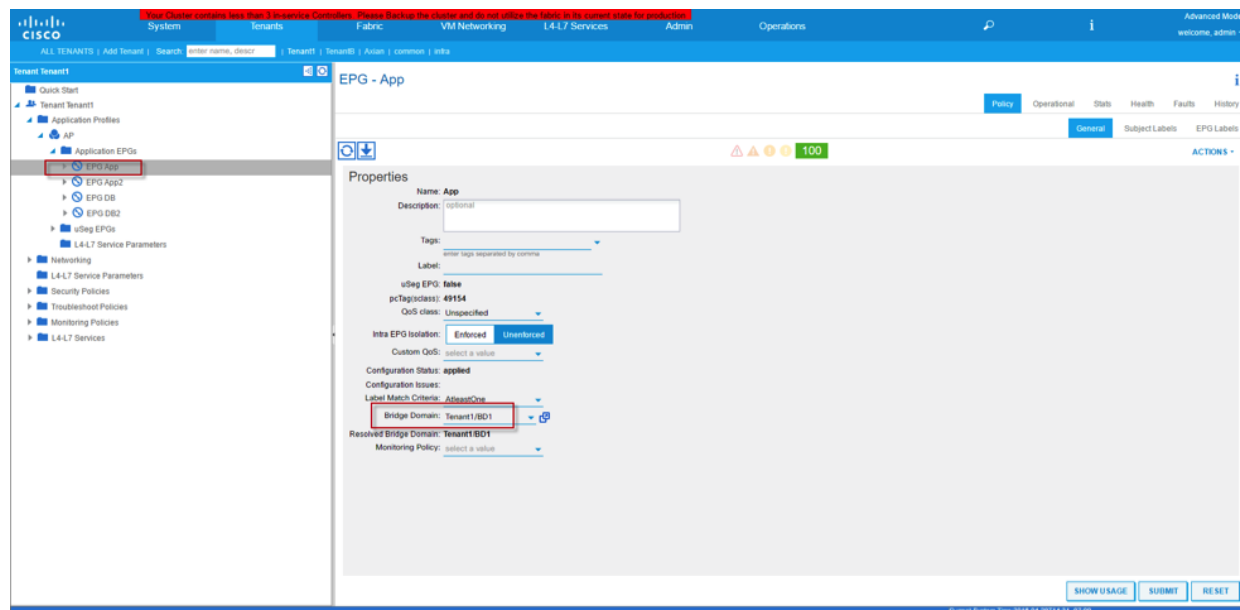


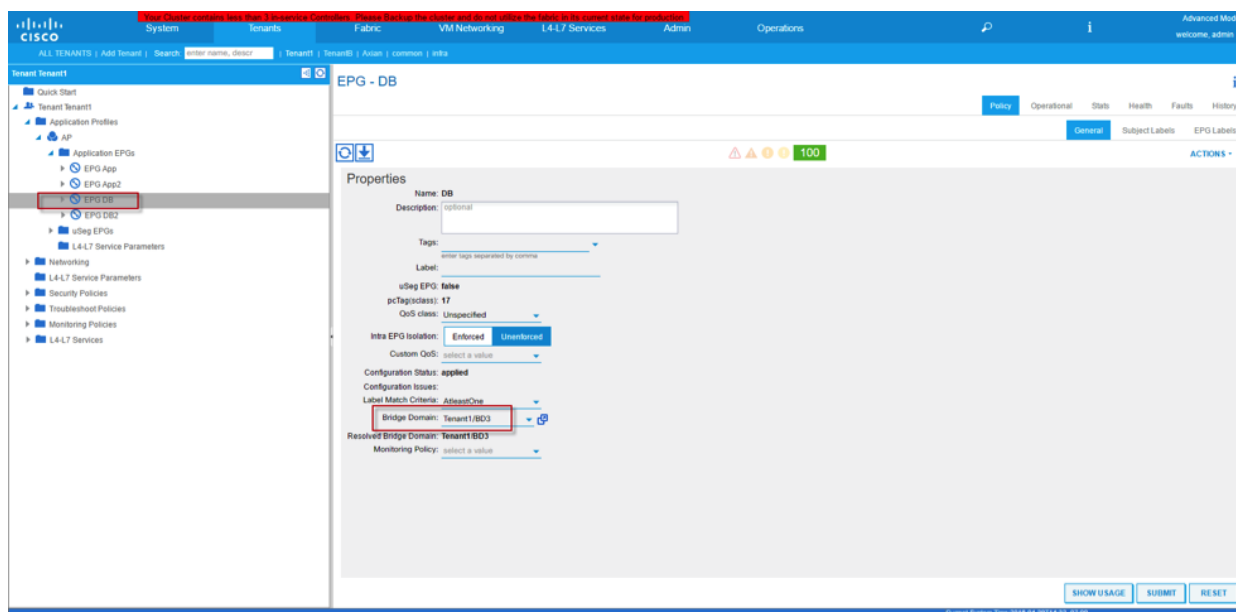
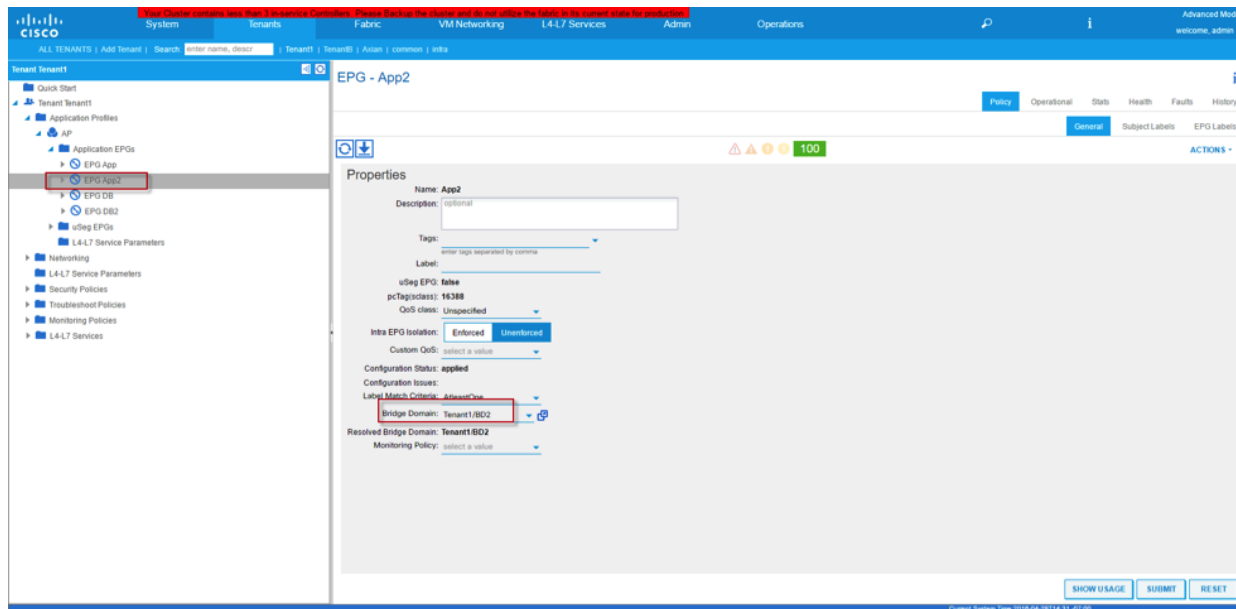


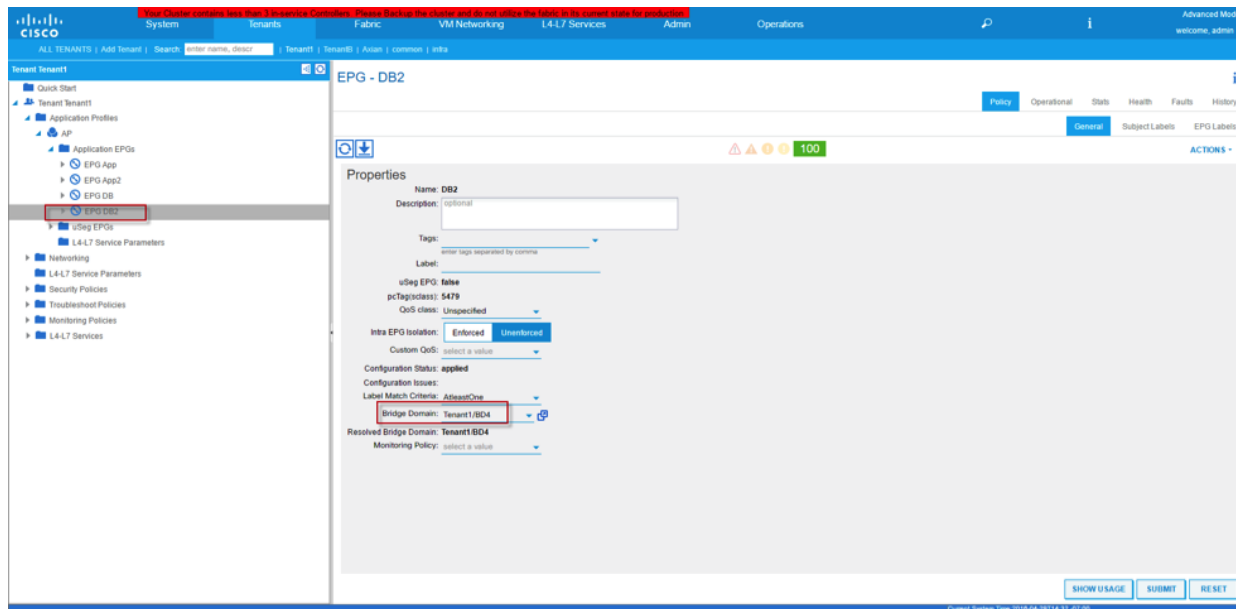
## Create 4 EPGs



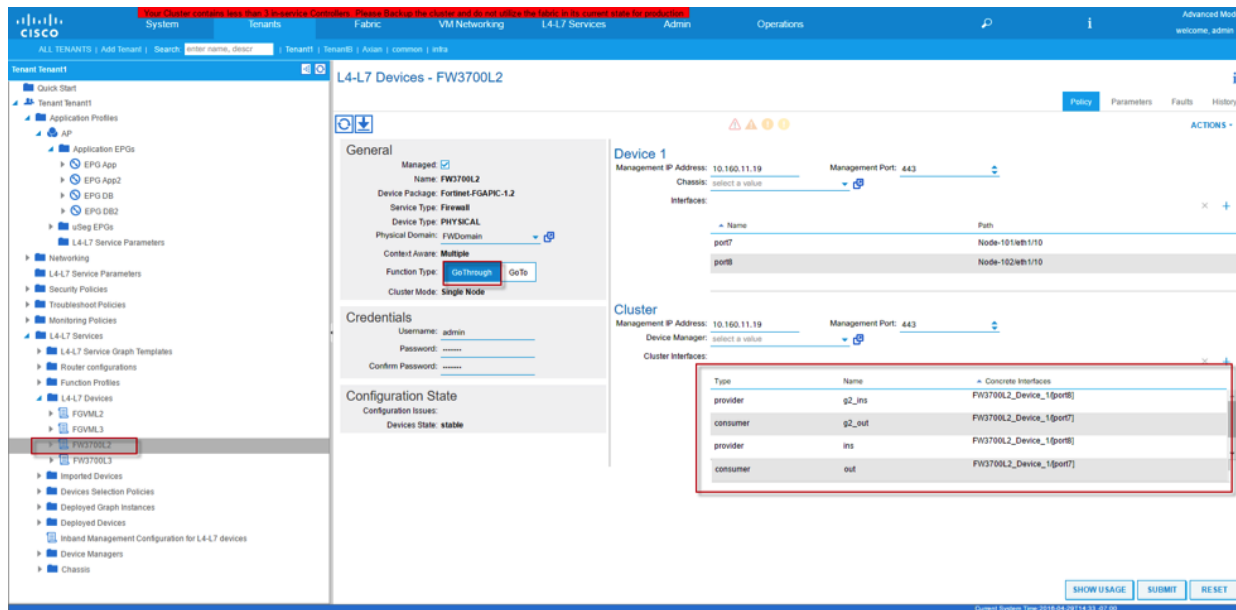
## Associate EPG “App”, “App2”, “DB” and “DB2” to Bridge Domain “BD1”, “BD2”, “BD3” and “BD4” respectively





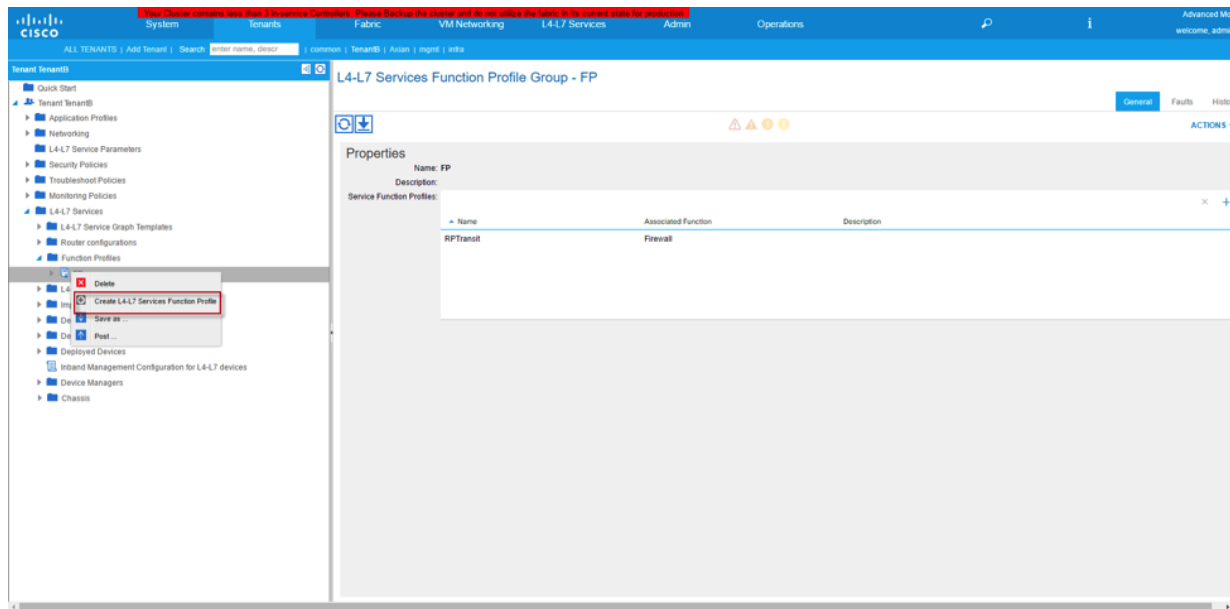


## Create Device with Go-Through mode with 4 logical interfaces on Cisco APIC (“Ins” and “Out” for Service Graph 1, “g2\_ins” and “g2\_out” for Service Graph 2)



## Create Functional Profile

Functional Profile defines the template for the Service(s) that is going to deploy such as L4-L7 Device Interface IP addresses, Rule ID, Object Addresses, Policy Rules, Source/Destination Ports...etc.



## Functional Profile Objects Explanation under “Features”

### Device Network

Contained External and Internal Interfaces that will be programmed onto Fortigate VDOM. This is the interfaces (typically external and internal) that will be associated to the VDOM. Please leave the field in this section untouched for Go-Through mode deployment.

### Firewall Objects

This field allows user to customize Firewall Addresses, Service and scheduling.

### Firewall Policy Rule

This field encompassed the creation of Firewall policy that will be program onto Fortigate. Security Profile and Logging Options are also configured here.

### Static Router

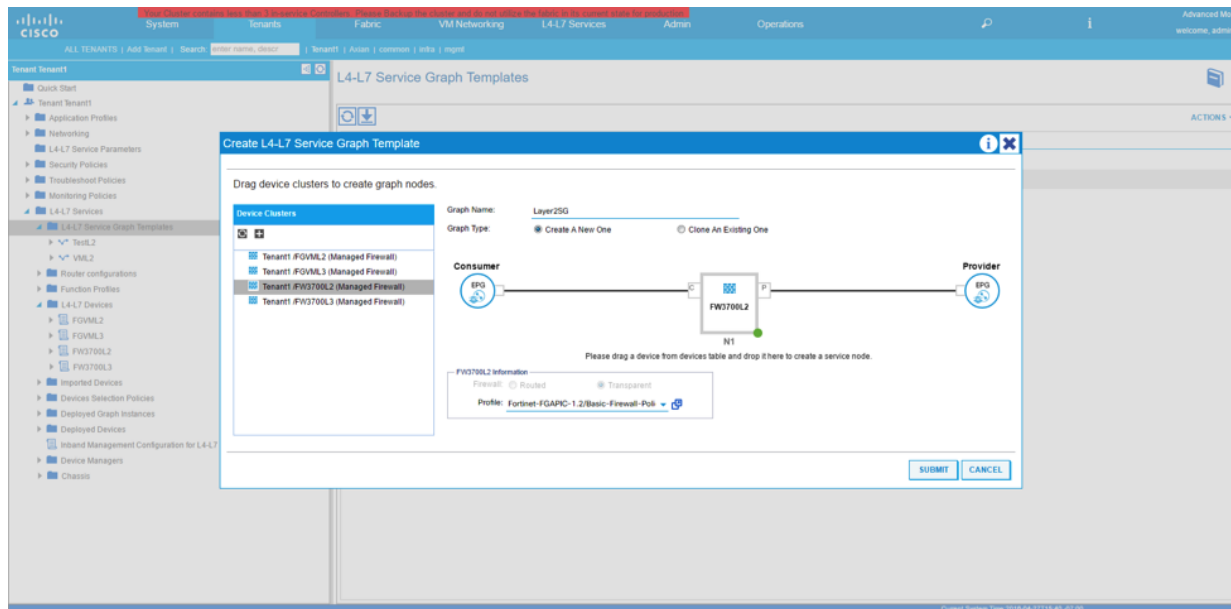
Allow user to configure static route that will be used on Fortigate.

### All

This field listed all the parameters stated above plus DDOS configuration.

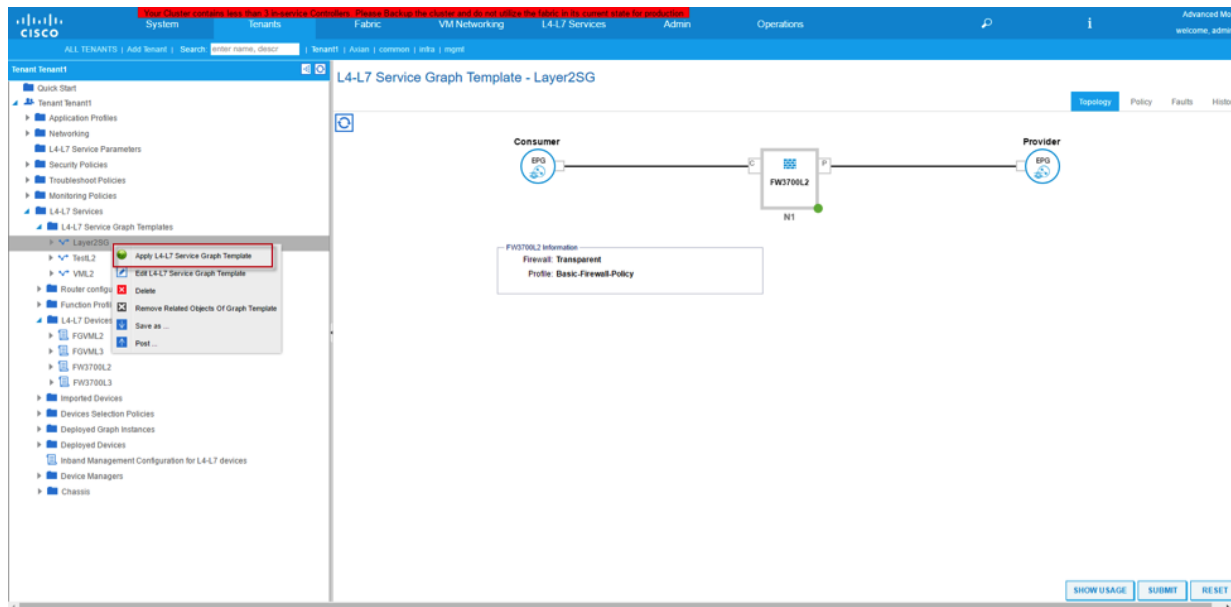
## Create Service Graph1

Service Graph template is used to tightly coupled the Functional Profile or Firewall configuration and combine with the Firewall device we defined at earlier steps.

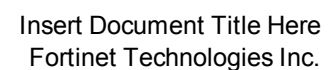
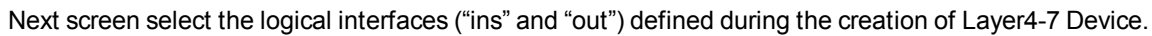


## Deploy Service Graph1

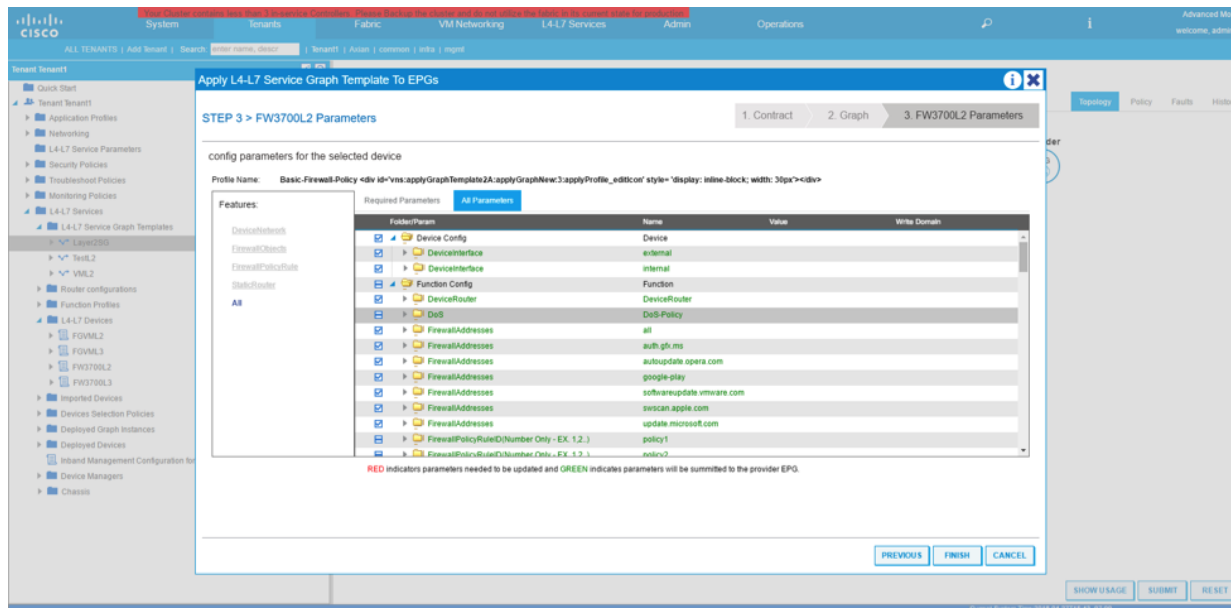
Once we combined the Firewall configuration and associated device together, we are ready to deploy Service Graph 1



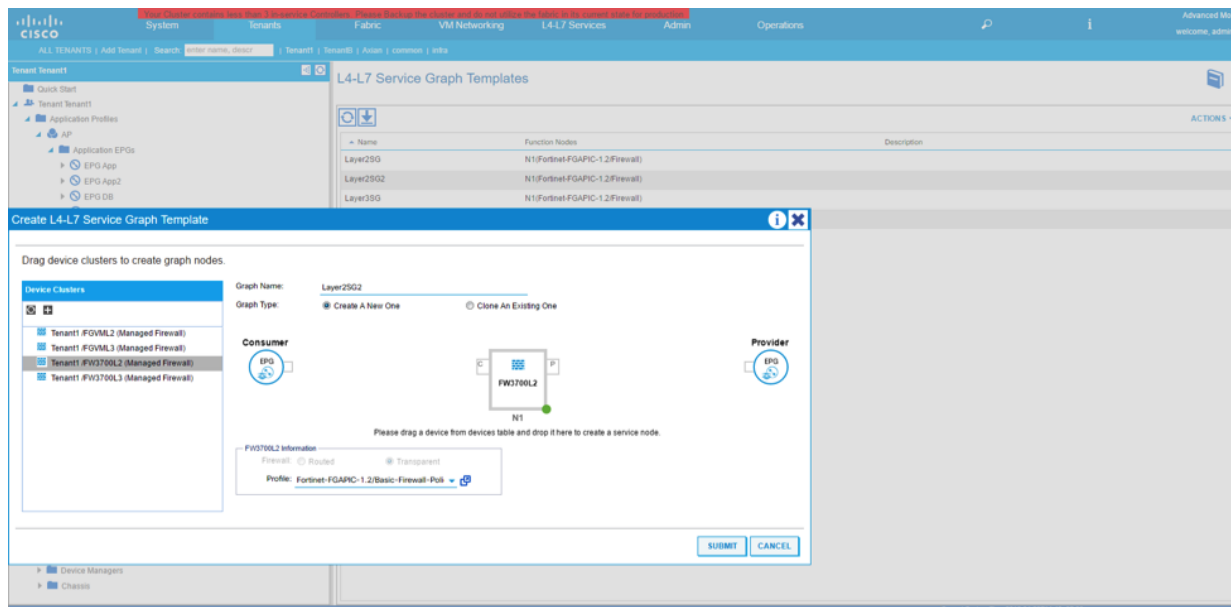
On next screen select the Consumer and provider EPGs (“Apps” and “DB”) and assign a contract name or select a pre-define contract.



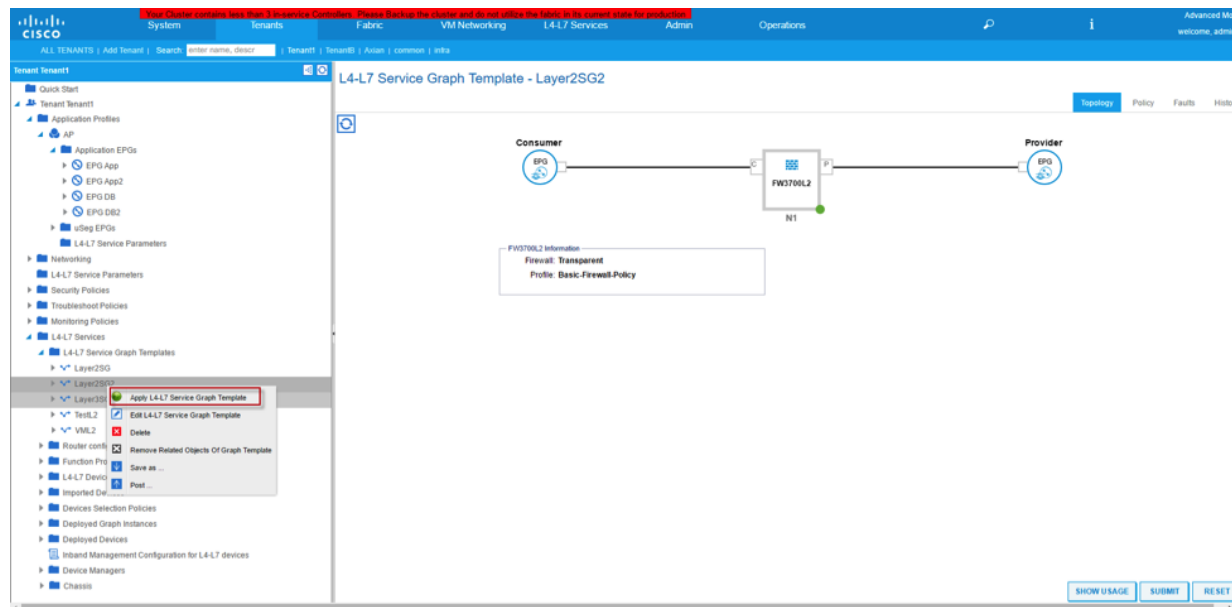
## Last minute check to make sure configuration is good before hit “Finish” button



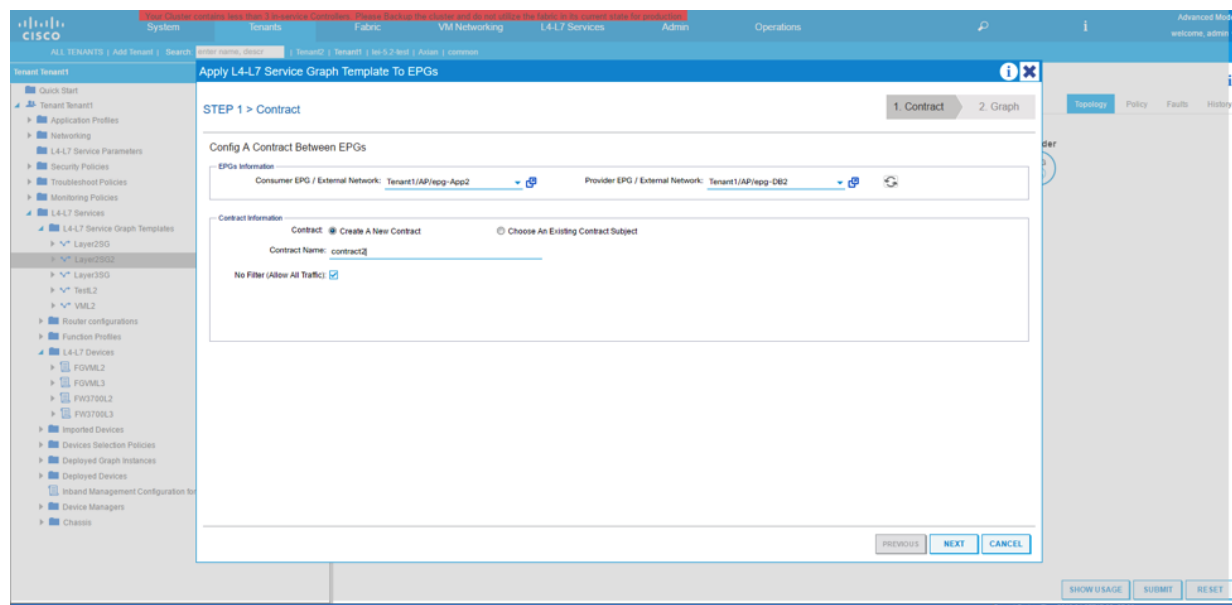
## Create Service Graph2



## Deploy Service Graph2

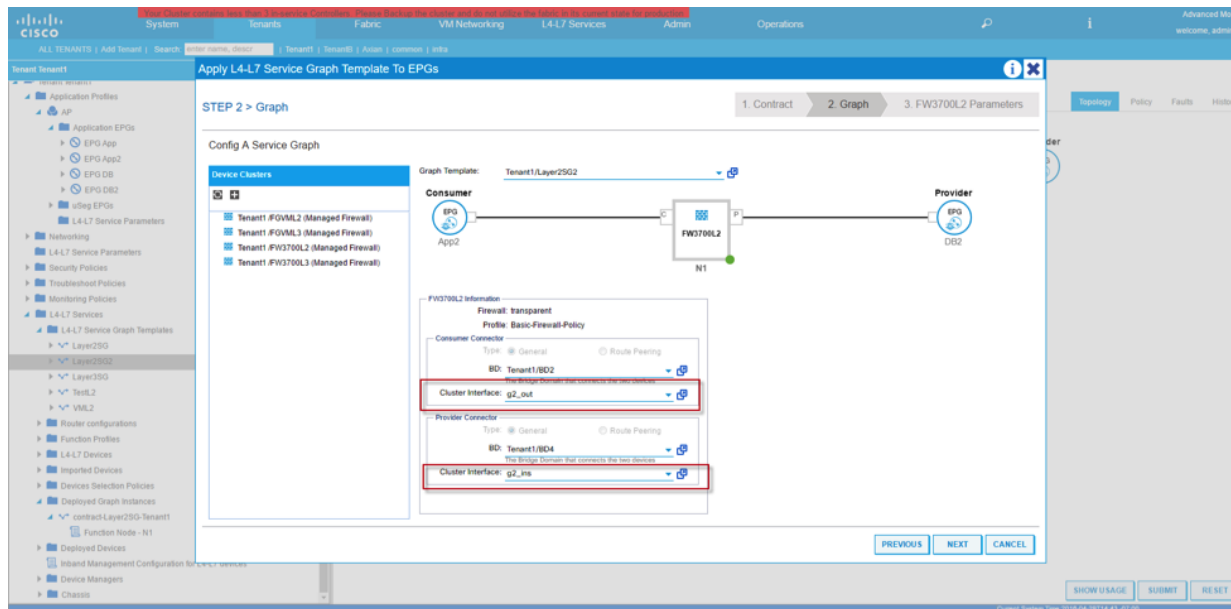


On next screen select the Consumer and provider EPGs (“Apps2” and “DB2”) and assign a contract name or select a pre-define contract.

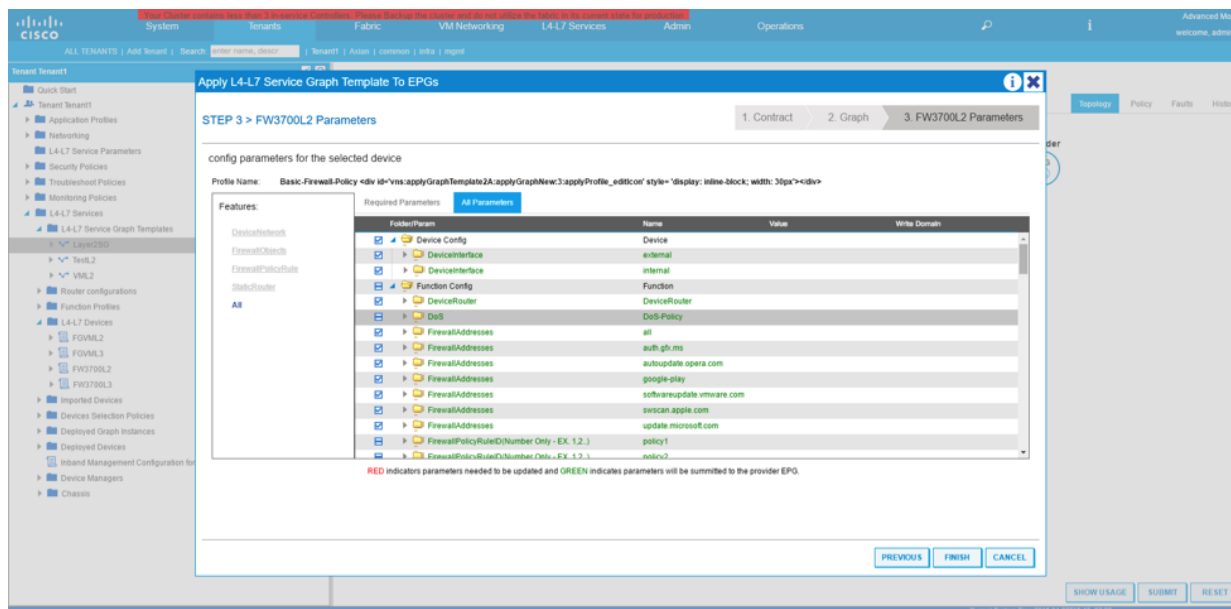


Next screen select the same logical interfaces (g2\_ins and g2\_out) defined during the creation of Layer 4-7 Device.





Last minute check to make sure configuration is good before hit “Finish” button



## Verify Device Selection Policies Creation

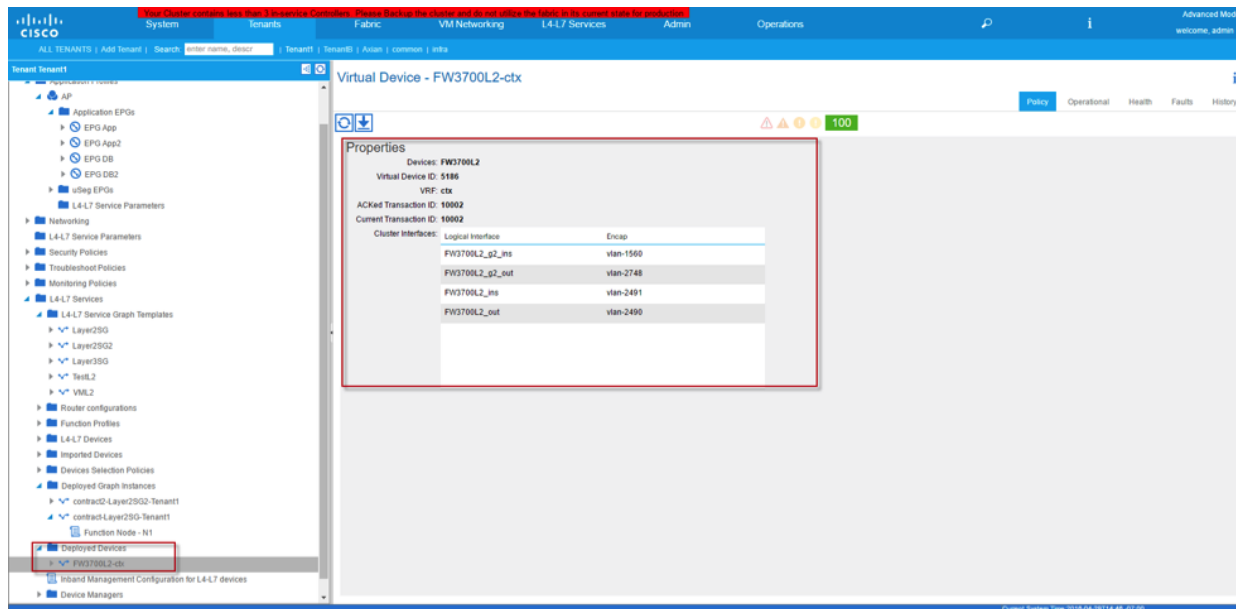
The screenshot shows the Cisco SD-WAN GUI for a tenant named 'Tenant1'. The 'Devices Selection Policies' page is active. The left sidebar shows the navigation tree with 'Devices Selection Policies' highlighted. The main panel displays a table with columns: Contract Name, Graph Name, Node Name, and Logic Device. Two policies are listed: 'contract' with 'Layer290' and 'contract2' with 'Layer2902'. Both are associated with 'N1' and 'Tenant1FW3700L2'.

Contract Name	Graph Name	Node Name	Logic Device
contract	Layer290	N1	Tenant1FW3700L2
contract2	Layer2902	N1	Tenant1FW3700L2

## Verify Service Graphs Deployment

The screenshot shows the Cisco SD-WAN GUI for a tenant named 'Tenant1'. The 'Deployed Graph Instances' page is active. The left sidebar shows the navigation tree with 'Deployed Graph Instances' highlighted. The main panel displays a table with columns: Service Graph, Contract, Contained By, State, and Description. Two instances are listed: 'Layer290' with 'contract' and 'Layer2902' with 'contract2'. Both are associated with 'Tenant1' and have a state of 'applied'.

Service Graph	Contract	Contained By	State	Description
Layer290	contract	Tenant1	applied	
Layer2902	contract2	Tenant1	applied	



## Deploying High Availability Service with Cisco ACI and FortiGate

### Pre-requisite

#### On Fortigate:

- Configure Fortigate HA Pair (Active-Standby Mode). Please consult Fortinet support website for setting up HA procedures.

#### On APIC:

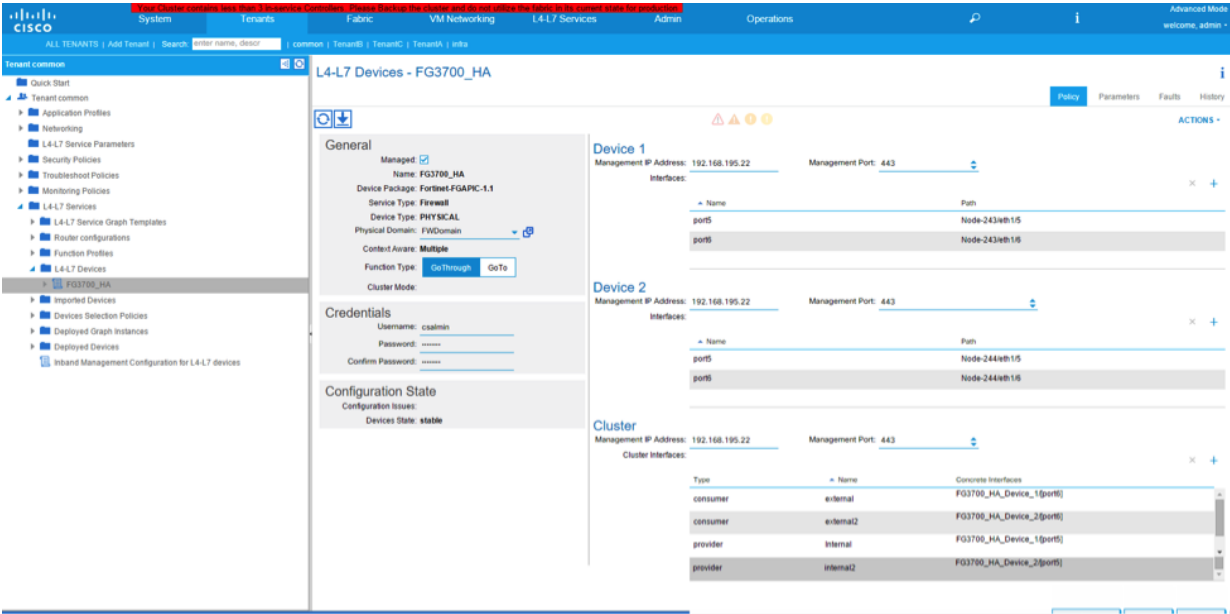
- Fabric Access Policies creation relating to VLAN Pools, Domain, Attachable Access Entity Profiles, Interface Policies and Switch policies.
- Create Tenant, VRF, 2 Bridge Domains, 2 EPGs
- Associate 2 Bridge Domains to VRF
- Associate 2 EPGs to the 2 Bridge Domains
- Layer 4-7 Device Package has imported into Cisco APIC

### Work Flow:

1. Create Go-Through Mode with HA enabled, then configure Device #1 and Device #2 on Cisco APIC
2. Create Functional Profile
3. Create Service Graph Template
4. Deploy Service Graph

In general, the procedures to deploy a Go-Through mode HA scenario vs regular Go-Through mode deployment are identical with the exception of enabling HA during L4-L7 device configuration. User needs to select HA Cluster

instead of Single Node for Mode selection; there will be two devices appear on the screen where user will input the same Active Fortigate IP address and the corresponding connection ports between Fortigates and Cisco APIC for both devices. Please see below screen shot for reference.



## APIC Infrastructure and FortiGate rollback

1. Upload and unload device package
2. Add and Delete device, FortiGate should clean-up previous configuration.
3. Dynamically modify and update policies
4. Detach and Attach service graphs
5. Delete tenants while service graphs in use.

# Basic Troubleshooting

## Verify Service Graph deployed

If Service Graph Deployed failed:

Navigate under **Tenant > Deployed Graph Instances** to check the state of the deployed graph.

If state is **failed apply**, then go down one level to the **Deployed Graph Instances** and navigate to the **Fault** tab to check the error log. Any error code in 1000 range are relating to FortiGate while others belong to APIC

Currently we only have the following error code:

Error Code	Definition
1010	Configuration Error in device configuration
1020	Configuration Error in function configuration
1030	Internal Error -3
1040	Internal Error -4
1050	Internal Error -5
1070	Feature not available

**Deployed Graph Instances**

CONTRACT	STATE	SERVICE GRAPH	CONTAINED BY	FUNCTION NODES
L3contract	failed-to-apply	Test2SG	Tenant: Ten2	Firewall

**L4-L7 Service Graph Instance - democontract-Test2SG-Ten2**

SEVERITY	ACKNOWLEDGED	CODE	CAUSE	CREATION TIME	LAST TRANSITION	AFFECTED OBJECT	LIFECYCLE	DESCRIPTION
Success	<input type="checkbox"/>	P0758	graph-rendering failed	2015-09-17T16:15:41.725-07:00	2015-09-17T16:18:50.373-07:00	unlbn-Ten2/GraphInst_C[unlbn-Ten2]democontract2-C[unlbn-Ten2]democontract2-C[unlbn-Ten2]	Retaining	Service graph for tenant Ten2 could not be instantiated. Info: L4-L7 has fault: Tenant Ten2, L4-L7 Devices FGVM1000
Success	<input type="checkbox"/>	F1307	resolution failed	2015-09-17T16:15:41.568-07:00	2015-09-17T16:16:44.214-07:00	unlbn-Ten2/GraphInst_C[unlbn-Ten2]democontract2-C[unlbn-Ten2]democontract2-C[unlbn-Ten2]democontract2-C[unlbn-Ten2]	Retaining	Failed to form relation to HG unlbn-Ten2/PortName-External-1:1000-Firewall/InConn-external of class unshConn
Success	<input type="checkbox"/>	F1307	resolution failed	2015-09-17T16:15:41.670-07:00	2015-09-17T16:16:44.222-07:00	unlbn-Ten2/GraphInst_C[unlbn-Ten2]democontract2-C[unlbn-Ten2]democontract2-C[unlbn-Ten2]democontract2-C[unlbn-Ten2]	Retaining	Failed to form relation to HG unlbn-Ten2/PortName-External-1:1000-Firewall/InConn-external of class unshConn

## Service deployed but parameters missing

If Service deployed but certain parameters not showing up on Fortigate, please follow the below steps:

1. Navigate to **Tenant > Provider EPG > L4-L7 Parameters**, ensure the missing parameters are listed. If not, double check the functional profile to confirm the configuration







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